ACRONYMS

AC	Alternative Current
APU	Auxiliary Power Unit
BC	Battery Contactor
BIT	Built In Test
BTC	Bus Tie Contactor
CAS	Crew Alerting System
CB	Circuit Breaker
CLSC	Cabin Load Shed Contactor
CMC	Central Maintenance Computer
DC	Direct Current
ECU	Electronic Control Unit
EEC	Engine Electronic Controller
FADEC	Full Authority Digital Electronic Control
FBW	Fly By Wire
GCU	Generator Control Unit
GLC	Generator Line Contactor
GLSC	Galley Load Shed Contactor
GPC	Ground Power Contactor
GPU	Ground Power Unit
GSB	Ground Service Bus
LFSPDB	Left Front Secondary Power Distribution Box
LH	Left Hand
LPPDB	Left Primary Power Distribution Box
LRSPDB	Left Rear Secondary Power Distribution Box
LS	Load shed
MAU	Modular Avionic Unit
MDU	Multi function Display Unit
MMEL	Master Minimum Equipment List
O/C	OverCurrent
OP	Overhead Panel
OVHT	OVerHeaT
PDCU	Power Distribution Control Unit
PFCS	Primary Flight Control System
PMA	Permanent Magnet Alternator
PPDB	Primary Power Distribution Box
RAT	Ram Air Turbine
RATC	Ram Air Turbine Contactor

RFSPDB	Right Front Secondary Power Distribution Box
RH	Right Hand
RPPDB	Right Primary Power Distribution Box
RRSPDB	Right Rear Secondary Power Distribution Box
S/G	Starter Generator
SOV	Shut Off Valve
SPDB	Secondary Power Distribution Box
SSPC	Solid State Power Controller
TRU	Transformer Rectifier Unit
VDC	Volt Direct Courant

INTRODUCTION

The Falcon 7X uses 28 Volts DC power for operation of the various systems installed in the airplane.

The electrical system is supplied by:

- Three engine-driven generators,
- Two Batteries,
- A RAT in some emergency cases.

The Primary Flight Control System and Engine Electronic Controller are also powered by dedicated Permanent Magnet Alternators.

On ground, the electrical system can also be supplied by:

- An Auxiliary Power Unit (APU) driven generator,
- An external 28 DC GPU (Ground Power Unit).

The different electrical power sources provide power to six buses installed in two Primary Distribution Boxes:

- LH ESSential and LH MAIN buses,
- RH ESSential and RH MAIN buses,
- Batt 1 and Batt 2 buses.

Electrical Power is distributed from the two Primary Power Distribution Boxes (PPDB) toward four Secondary Power Distribution Boxes (SPPD) installed forward and aft of the airplane, on the Right and Left Hand sides.

Protection of equipment, cables, and electrical buses is provided by different control boards, by fuses and by mechanical and electronic Circuit Breakers (CB).

The Emergency lighting system is fitted with dedicated batteries.

➢ *Refer to ATA 33 for additional information.*

There is no optional of equipment associated with the electrical system.

FLIGHT DECK OVERVIEW

CONTROLS

Crew has control over the electrical system via:

- The " DC SUPPLY" Panel on the overhead panel,
- The CB sub page of the ELEC synoptic,
- Two switches on the Emergency Panel (aft end of the pedestal) for RAT inhibit and "RH ESS ISOL",
- The RAT Manual Release Handle (right side of the pedestal),
- The Fire Control Panel in case of engine fire, to confirm generator disconnection,
- The Servicing sub page of TEST synoptic for "ground servicing bus".

NOTE

Circuit Breakers are not accessible in the cockpit. CB are installed in the different Distribution Boxes. The "CB page" of the ELEC synoptic allows modifying status of electronic CB on ground only. In flight, the "CB page" provides the status of the mechanical and electronic CB.

INDICATIONS

Indications related to the Electrical System configuration and status are displayed in:

- The "DC SUPPLY" Panel (on the overhead panel),
- The ELECtrical System Synoptic and subpage "Circuit Breaker",
- The TEST synoptic page,
- The ENG-CAS window for CAS messages,
- The STATus synoptic / FAULT tab for fault messages.

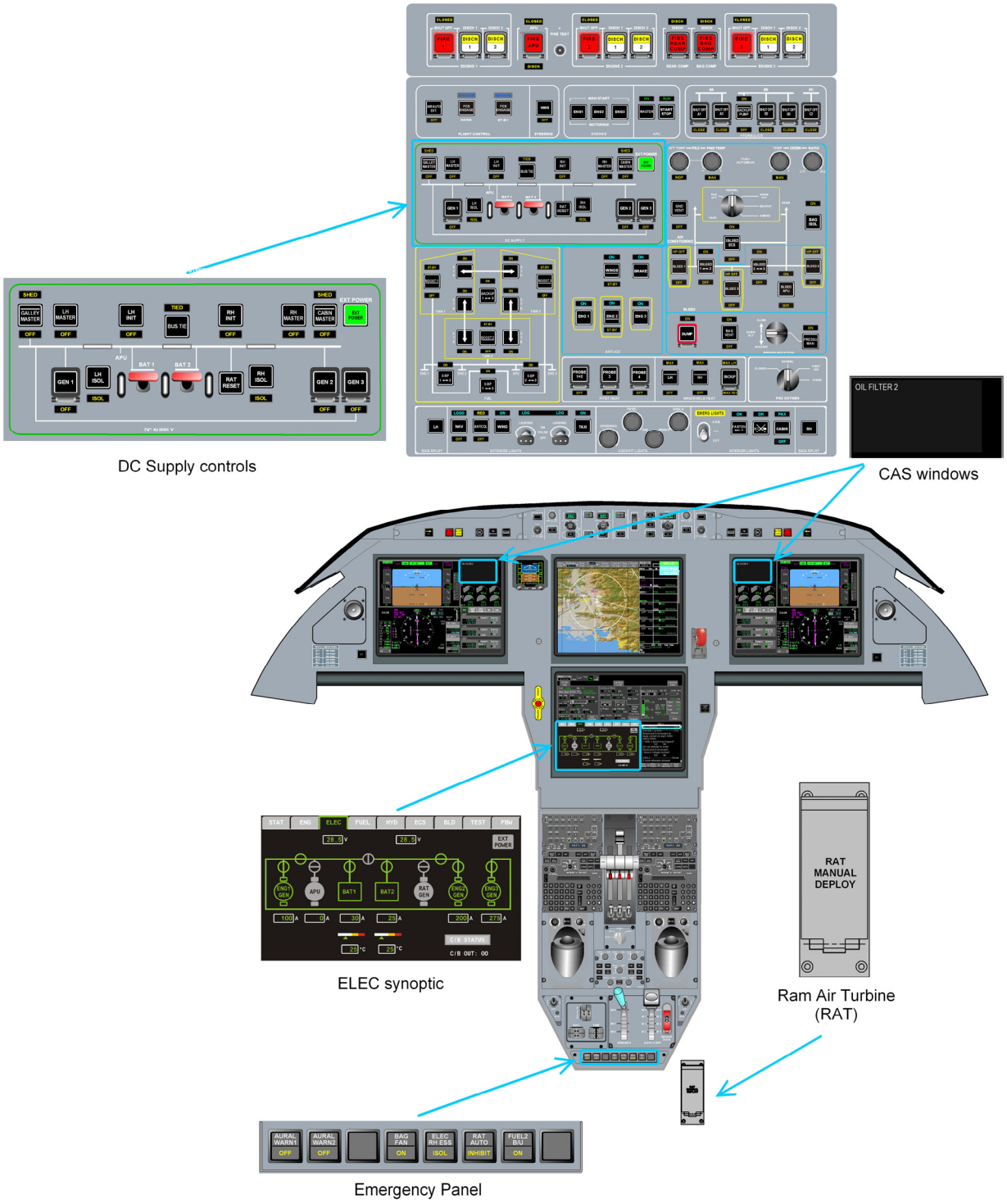


FIGURE 02-24-05-00 - FLIGHT DECK OVERVIEW

GENERAL

The Electrical Power system provides following functions:

- Electrical power generation and energy storage,
- Electrical power distribution,
- Protection of electrical components.

Following general diagram of the electrical system shows:

- The different sources of electrical power,
- The repartition of buses in the Primary Distribution Boxes,
- The distribution of electrical power toward the Secondary Distribution Boxes and other loads.

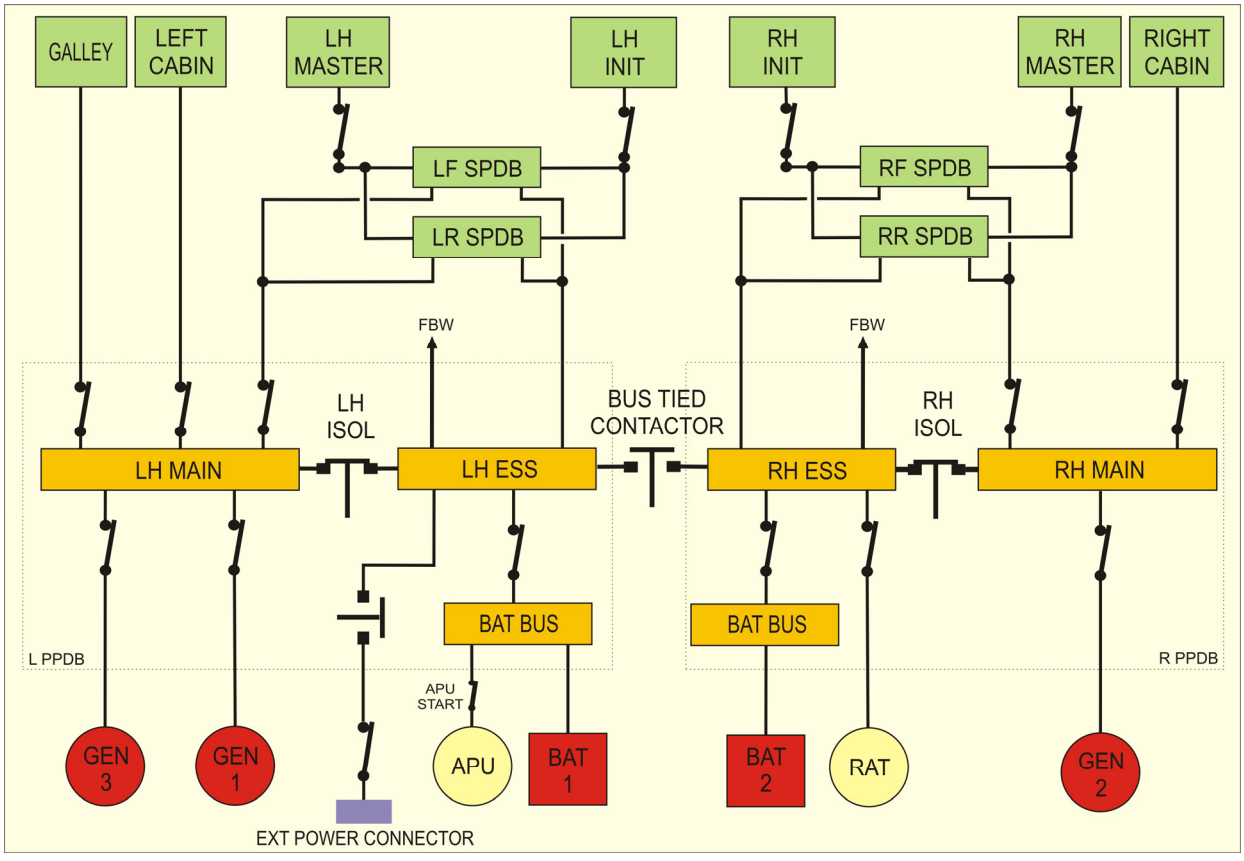


FIGURE 02-24-10-00 - ELECTRICAL SYSTEM DIAGRAM

POWER GENERATION AND ENERGY STORAGE

GENERAL

In flight, the 28Vdc generation is provided by:

- 3 engine driven generators: 12kW (500 A),
- A RAT (Ram Air Turbine) which can provide a non time limited electrical power (9 kW) to LH and RH Essential Buses.

On ground, the 28Vdc generation is provided by:

- An APU starter-generator: 12 kW (400 A),
- A 28Vdc GPU which can be connected to the airplane to energize the entire electrical system.

Additionally,

- Two PMA (Engines 1 and 2) provide an independent source of electrical power for the PFCS,
- Three PMA (Engines 1, 2 and 3) provide an independent source of electrical power to Engine Electronic Controllers EEC.

Electrical energy is stored in two 24 V dc (25 Ah) lead-acid batteries.

ENGINE-DRIVEN GENERATORS

Engine-driven generators are driven by the accessory gearbox of each engine.

Engine driven generators are rated at 12 kW, but they can provide 15 kW for a limited time in case of a generator failure. They are regulated at 28.5 VDC by a Generator Control Unit (GCU) associated to each engine.

Each GCU provides current and voltage control and protection for its associated generator.

APU GENERATOR

The Auxiliary Power Unit (APU) is equipped with a starter-generator. As a generator and for ground use only, it provides DC power to airplane systems and batteries charging.

The APU is rated at 12 kW and regulated at 28.5 VDC by its associated GCU.

The APU Generator Control Unit (GCU):

- Provides current and voltage control and protection for its associated generator,
- Controls APU start sequence.

BATTERIES

On ground, two 24 V dc (25 Ah) lead-acid batteries provide the primary source of DC power to the entire distribution system prior to APU starting.

The BAT1 supplies electrical power for starting the APU.

NOTE

Very low-charged batteries cannot be connected to the buses,
as their contactors need at least 18 VDC to close.

As soon as one generator is connected, batteries are charging and flatten generator electrical spikes.

The batteries are also used in case of main generators loss, during the RAT deployment and additionally just before landing when low airspeed does not allow the RAT to provide sufficient electrical power.

In flight, the batteries can provide electrical power for a load of 200 A for 7 minutes.

RAM AIR TURBINE

The Ram Air Turbine (RAT) system provides a non-time limited electrical power source 9kw to the RH and LH Ess bus for continued safe flight and landing in case of:

- Loss of all three engines (automatic deployment),
- Loss of all three engine generators (automatic deployment),
- Loss of engine 2 generator and short on LH ESS bus (manual deployment),
- Loss of engine 2 generator and BUS TIE contactor failed open (manual deployment).

When operative, the RAT will charge the airplane batteries.

When the airplane speed is low (approach and landing), the RAT generator output voltage is reduced, and batteries start providing power. In this manner both the RAT and batteries power all the required airplane loads during this phase.

NOTE

A safety lock pin with a **REMOVE PIN BEFORE FLIGHT** flag is used
to preclude inadvertent deployment of the RAT on ground.

The RAT is fitted with a RAT generator heater that is powered during all phases of flight, except when the RAT is deployed and in operation. The purpose of the heater is to prevent moisture within the air gap of the generator from freezing.

When deployed, the RAT induces a moderate level of noise and vibration in the cockpit.

Once the RAT is deployed, it will have to be restowed on ground with a restow pump.

PMA

Two PMA (Permanent Magnet Alternator) driven by engines 1 and 2 provide an independent source of power to the Primary Flight Control system.

Three PMA driven by each engine provide an independent source of AC power for their respective EEC (Engine Electronic Controller).

GPU

An approved 28 VDC Ground Power Unit (GPU) may be used for prolonged periods to power the DC system in order to facilitate maintenance and servicing.

The GPU may also be used:

- For APU starting (recommended power is 1,000 A),
- To charge the batteries.

The GPU will not provide power to the distribution system simultaneously with APU generator or engine-driven generators. Order of priority is the following:

- The APU generator will provide power to the distribution system only once the GPU is off line,
- The GPU is automatically disconnected from electrical buses when one engine-driven generator comes on line.

POWER DISTRIBUTION

GENERAL

The different electrical power sources provide power to six buses:

- BATT1 bus: powered by battery 1 or APU generator,
- LH MAIN bus: powered by Engines 1 and 3 generators,
- LH ESSential bus: powered by BATT1 bus,
- BATT2 bus: powered by battery 2,
- RH ESSential bus: powered by BATT2 bus, and potentially by the RAT generator,
- RH MAIN bus: powered by Engine 2 generator.

An additional bus is considered for preflight use only: Ground Servicing Bus.

The six buses are gathered in two Primary Distribution Boxes:

- LH PPDB contains:
  - LH MAIN and ESSential buses,
  - BATT1 bus
- RH PPDB contains:
  - RH MAIN and ESSential buses,
  - BATT2 bus

Power is distributed:

- from the two Primary Power Distribution Boxes (PPDB),
- Toward:
  - The four Secondary Power Distribution Boxes (SPDB),
  - Galley and cabin loads,
  - Hot loads,
  - Some PFCS loads.

Control and protection of contactors and buses within the Primary Power Distribution Boxes (PPDB) is performed by Primary Distribution Control Units (PDCU).

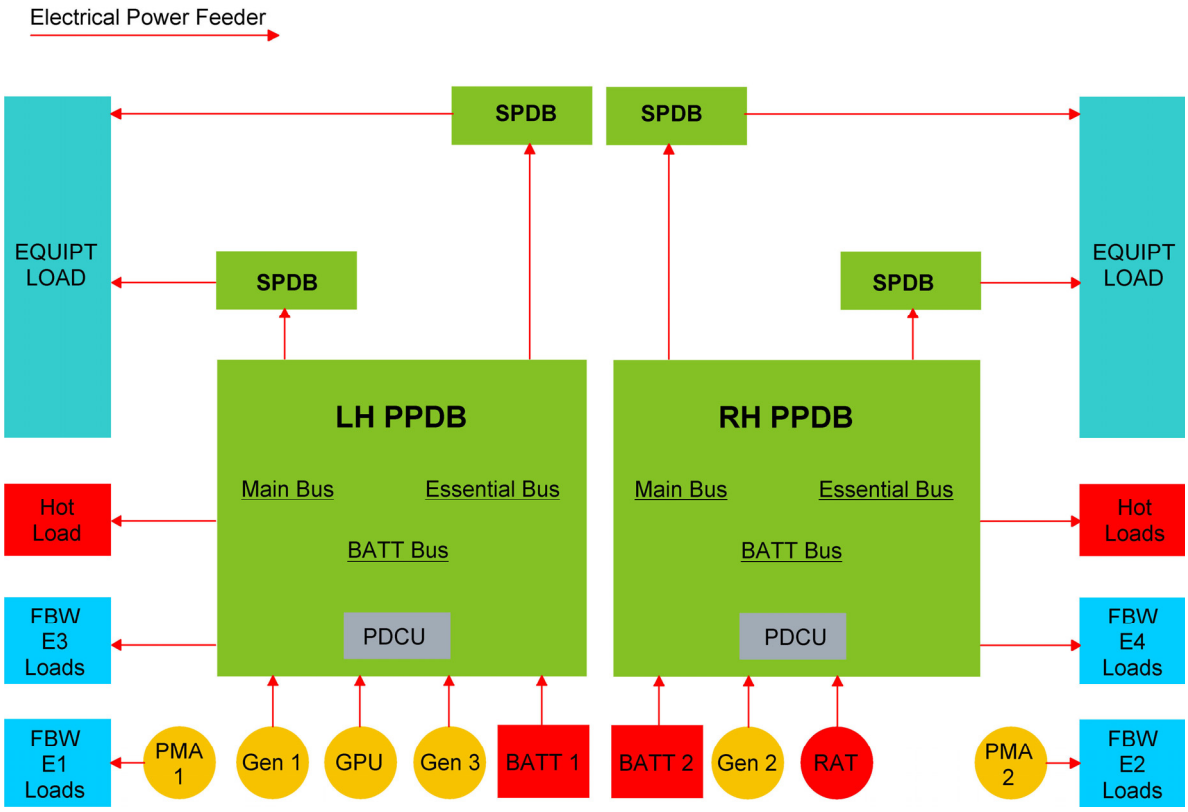


FIGURE 02-24-10-01 - POWER DISTRIBUTION

PRIMARY POWER DISTRIBUTION BOX (PPDB)

The LH and RH Primary Power Distribution Boxes contain:

- Essential, Main and Battery buses,
- Powers Distribution Control Unit (PDCU),
- Engines and APU Generators GCU Cards,
- Lines contactors , Bus Tie Contactors (BTC),
- Thermal fuses and Circuit Breakers (CB).

SECONDARY POWER DISTRIBUTION BOX (SPDB)

Each of the SPDB performs similar functions. The main difference is the location in the airplane, and the variation in the number of connections to the airplane wiring. The four SPDB:

- Receive electrical power inputs from LH and RH PPDB,
- Distribute electrical power to Equipments loads via feeder cables,
- Ensure protection of cables and monitor the status of supply to the different airplane equipment.

Each SPDB contains:

- Power supply,
- Circuit breakers,
- Electronic CB (SSPC) for the rear SPDB.

BATTERY BUSES

The battery buses are powered as soon as the dedicated battery is installed and plugged in. Regardless of battery switch position, the battery bus provides electrical power directly to:

- The Ground Service Bus (GSB),
- The refueling system,
- The engine FIRE extinguishers secondary discharge,
- The fuel shut-off valves,
- The access door lighting.

GROUND SERVICE BUS

The Ground Service Bus powers a limited number of RH ESS bus equipment without the need to power up the entire electrical distribution.

The Ground Service Bus is accessible via the maintenance panel.

The Ground Service Bus operation is limited to 3 minutes by a circuit timer.

NOTE

With ambient temperatures below 0°c do not operate the Ground Service Bus (Battery Load).

POWER DISTRIBUTION CONTROL UNIT (PDCU)

Each Primary Power Distribution Box (PPDB) is controlled through a Primary Distribution Control Unit (PDCU) that manages:

- Batteries, buses ties, load shed cabin, galley, GCU contactors,
- In accordance with load shedding and fault isolation logic.

The load shedding is controlled by the two PDCU by opening contactors when electrical power sources can not supply all airplane loads.

➢ *Refer to "System Protections" section for these load-shedding logics.*

DESIGN PRINCIPLES

The electrical system was designed considering technology, architecture, safety and maintenance design principles.

TECHNOLOGY:

Since a low level of loads is required by airplane equipment, the electrical system circuit is a 28Vdc design. This allows simplification for circuit control and a good level of reliability without significant increase in weight.

Electronic CB (named SSPC) are used because their status can be modified by software, without direct access to the electronic CB.

ARCHITECTURE:

If the engines are running, the engines controllers and PFCS remain powered by dedicated power sources even if the airplane distribution system is not available.

Non time limited electrical power is available in case of all engines out or all generators failed, by a RAT.

In case of normal generation failure, the RAT system was selected rather than using the APU generator in flight: this way, the electrical system architecture is not affected by fuel contamination.

The galley and cabin load are directly powered from the PPDB in order to facilitate load-shedding logic.

Some PFCS loads are directly powered from the PPDB in order to be segragated from other system loads and to allow load shedding of SPDB in case of loss of engine-driven generators.

SAFETY:

The segregation of electrical energy to various points in the airplane is provided by two PPDB (Primary Power Distribution Box) and four SPDB (Secondary Power Distribution Box).

During flight, the left buses are segregated from right buses. So, in case of over-voltage or short-circuit inducing severe under voltage on one side, the other side is not affected.

In normal and abnormal conditions an automatic control of electrical system is simultaneously performed by the two PDCU and all Generator GCU. The Pilot has priority over PDCU automation, except in case of short circuit or overload protection.

MAINTENANCE:

Failures and fault detected by the system are sent in the form of ARINC message to the Central Maintenance Computer (CMC).

EQUIPMENT LOCATION

Equipment locations correspond to a physical segregation of components, power supplies, wiring routing, main and essential controls.

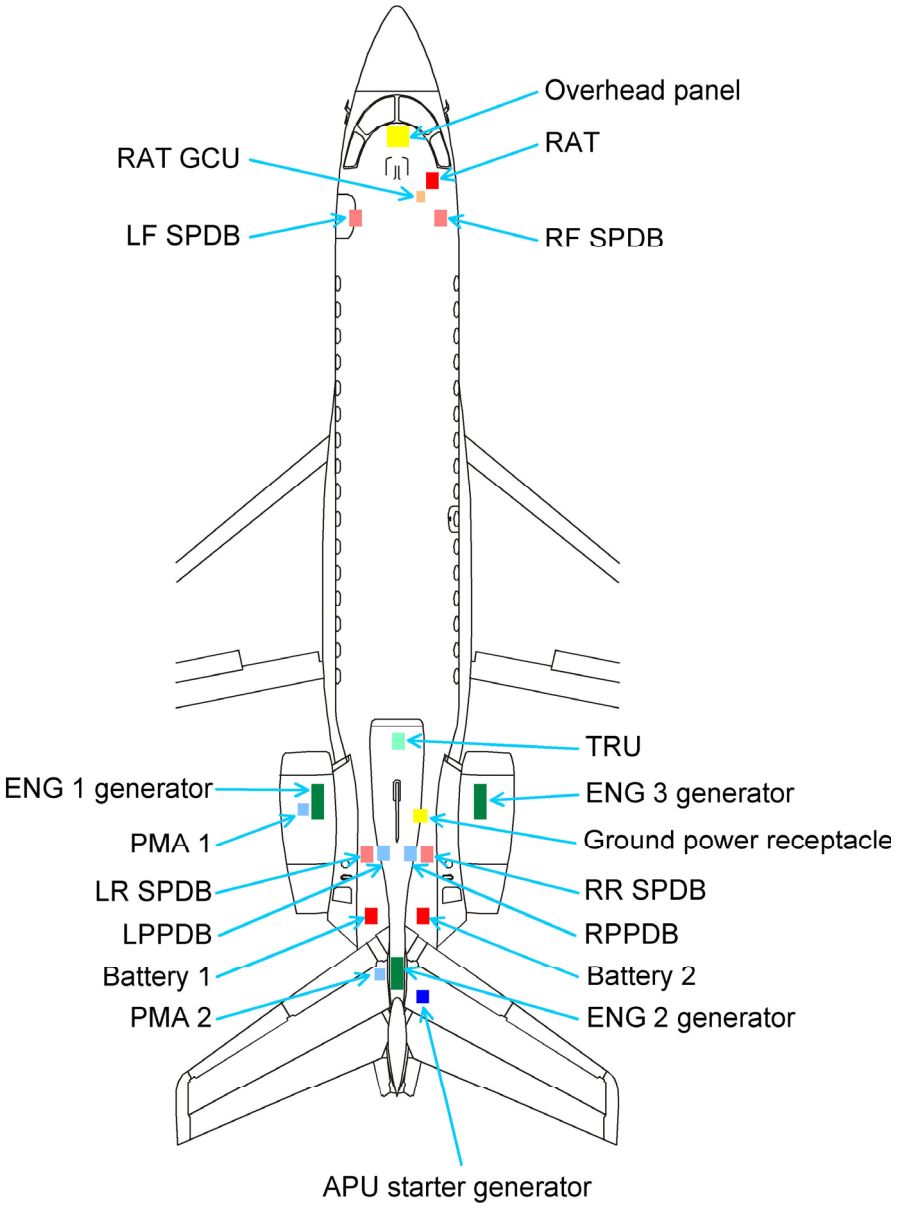


FIGURE 02-24-15-00 - ELECTRICAL SYSTEM - LOCATION OF EQUIPMENT

ELECTRICAL POWER DISTRIBUTION

Equipment load distribution is provided in following table:

LH MAIN BUS	LH ESS BUS	RH ESS BUS	RH MAIN BUS
ADSP 1 CH A HEAT	ADF 1	ADSP 3 CH B HEAT	ADF 2
ADSP 1 CH A	ADSP 3 CH A HEAT	ADSP 3 CH B	ADSP 1 CH B
ADSP 2 CH A HEAT	ADSP 3 CH A	ADSP 4 CH B	ADSP 1 CH B HEAT
ADSP 2 CH A	ADSP 4 CH A	ADSP 4 CH B HEAT	ADSP 2 CH B
AMSAC (AMM1, AMM3)	ADSP 4 CH A HEAT	AHRS 2	ADSP 2 CH B HEAT
ANTICOL LIGHT LH	AMSEC BALD	AMSEC EMM (RS)	AFT FLUSH
AUDIO PANEL 3	AMSEC EMM (LS)	AMSEC RH	AMSAC AMM2
AUTOTROTTLE	AMSEC LH	APU COMPUTER	ANTICOL LIGHT RH
BAG VENT LH	APU SOV	APU IGNITION	ATC 2
CCD CH B	AUDIO PANEL LH	AUDIO PANEL RH	AUDIO PANEL RH
DATA LOADER	ATC 1	B/U STAB	BAG VENT RH
DISPLAY UNIT LH	BAG ISOL VALVE CH1	BAG COMP FAN	BOOST PUMP 1
DME 1	BAT 1 HEATER	BAG COMP FAN CTRL	BOOST PUMP 3
EMERG LIGHT LH	BAT 1 MONITOR	BAG COMP SMOKE	BSCU #2
ENG 2 FADEC CH B	BOOST PUMP 2	BAG ISOL VALVE CH2	CCD CH B
ENG 2 IGN CH B	BSCU #1	BAT 2 HEATER	COCKPIT PRINTER
FASTEN BELTS	CAB VENT VALVE RH	BAT 2 MONITOR	DISPLAY UNIT LOWER
FBW TEST E2	CAB. OXYGENE AUTO	BSCU #2	DME 2
GALLEY	CCD LH CH A	CAB VENT VALVE LH	EMERG LIGHT RH
GEAR CH 2A	COMBINE RECORD. 1	CCD RH CH A	ENG 1 FADEC CH B
GND BAG VENT	DIPLAY UNIT LH	COMBINE RECORD. 2	ENG 1 IGN CH B
GUIDANCE PANEL LH	DISPLAY UNIT UPPER	DISPLAY UNIT RH	ENG 3 FADEC CH B
HF 1	EFCU (normal, first aid)	EBHA	ENG 3 IGN CH B
HF 1 R/E	ENG 1 ANTI-ICE	EFCU (override)	ENG 1,2,3 VIBRATION
HGS COMP FAN	ENG 1 FADEC CH A	ELT	FBW TEST E1
HUD HGS	ENG 1 IGN CH A	ENG 1 SOV	GUIDANCE PANEL RH
HUD OHU	ENG 2 SOV	ENG 2 ANTI-ICE	GND VENT VALVE
HUMIDIFIER	ENG 3 ANTI-ICE	ENG 2 FADEC CH A	HF 2
HYDR PRESS #A	ENG 3 FADEC CH A	ENG 2 IGN CH A	HF 2 R/E
HYDR PRESS #C	ENG 3 IGN CH A	ENG 3 SOV	ICE DETECTOR RH
ICE DETECTOR 1	FBW LF E3	FBW B/U UNIT	LANDING LIGHT RH
LANDING LIGHT LH	FBW LR E3	FBW LF E4	LGSCU CH 2
LFSPDB MAIN	FBW RF E3	FBW RF E4	LIGHT CTRL RH
LGSCU CH 2	FIRE EXT APU	FBW RR E4	LOGO LIGHT LOWER
LIGHT CTRL LH	FIRE EXT ENG 2	FIRE EXT BAG COMP	LSS
LOGO LIGHT LOWER	FIRE PANEL LH	FIRE EXT ENG 1	MAU 1 CH B
LRSPDB MAIN	FLCU LH	FIRE EXT ENG 3	MASTER WARNING &
MASTER WARNING &	FQMC LH	FIRE EXT R. COMP	CAUTION RH
CAUTION LH	FUEL PCB NORMAL	FIRE PANEL RH	MKB RH
MAINTENANCE EEC	GCU 1 PWR	FLCU RH	MRC 2 NIM
MAU 1 CH A	GCU 3 PWR	FQMC RH	NAV LIGHT (RH)
MAU 2 CH B	GUIDANCE PANEL LH	FUEL PCB STBY	OVERHEAD PANEL 3B
NAV LIGHT LH	HYDR 1A DEPRESS	GCU 2 PWR	POTABLE WATER
NO SMOKING	HYDR 2B DEPRESS	HYDR 3B DEPRESS	PRECOLLER ENG 2
NOSE FAN	HYDR 3A DEPRESS	HYDR PCB RH	QA RECORDER
OVERHEAD PANEL 3A	HYDR PCB LH	HYDR PRESS #B	RADIO ALT 2
OXYGENE MASK 3	HSECU	HYDR ST-BY PUMP	READING LIGHT RH

LH MAIN BUS	LH ESS BUS	RH ESS BUS	RH MAIN BUS
PRECOLLER ENG 1	IRS 1	IRS 2	REAR TOILET SMOKE
PDCU MAIN LH	LFSPDB ESS	IRS 3	RECIRC VALVE
PRECOLLER ENG 3	LGSCU CH 1	LGSCU CH 2	RFSPDB MAIN
RADIO ALT 1	LIGHTING MINIM. LH	LH PDCU B/U PWR	RRSPDB MAIN
READING LIGHT LH	LRSPDB ESS	LH WARNING RH	TAT 2 HEAT
REAR STROBE	MASTER WARNING &	LIGHTING MINIM. RH	TAXI LIGHT
SATCOM HPA	CAUTION RH	MAGNETOMETER	TPMU
SATCOM SDU	MAU 1 CH A	MASTER WARNING &	TOILETS SMOKE
TAT 1 HEAT	MKB LH	CAUTION LH	VHF 2
TCAS	MRC 1 NIM	MAU 2 CH A	VIDL-G 2
TEMP PROBE FAN	OVERHEAD PANEL 1A	OXYGENE MASK RH	WATER COMPRESSOR
TRUST REVERSER	OVERHEAD PANEL 2B	OVERHEAD PANEL 2A	WATER REHEAT HOSE
VHF 3	OXYGENE MASK LH	OVERHEAD PANEL 1B	WSCU
WEATHER RADAR	PDCU	PRECOLLER ENG 3	WSHIELD B/U RH
WING LIGHT LH	PRECOLLER ENG 1	RAIN REPELLANT RH	WING LIGHT RH
WOW RH	RAIN REPELLANT LH	RAT DEPLOY	WOW LH
WSHIELD B/U LH	RAT GCU TEST	RFSPDB ESS	
WSHIELD CTRL LH	RAT HEATER	RRSPDB ESS	
	REV PANEL LIGHT	SEAT/PEDAL RH	
	RH PDCU B/U PWR	SFAU BACKUP	
	RH WARNING LH	SFD	
	SEAT/PEDAL LH	SIDESTICK LH	
	SFAU	SIDESTICK RH	
	ST-BY BOOST 1	SLAT EMERG CTRL	
	ST-BY BOOST 3	ST-BY BOOST 2	
	THIRD OXYGEN MASK	TLA DISC RH	
	TLA DISC LH	TOILET SMOKE AFT	
	UPPER ANTICOL	TOILET SMOKE FWD	
	VIDL-G 1	WSHIELD BACKUP	
	VHF 1	WSHIELD RH	
	WOW LH	WOW RH	
	WSHIELD LH		

GENERATION DETAILED DESCRIPTION

Following figure shows the detailed description of contactors within the PPDB:

- BC 1/2: Bus Contactor 1/2
- BTC 1/2/3: Bus Tie Contactor 1/2/3
- CLSC 1/2:Cabin Load Shed Contactor 1/2
- GLC 1/2/3: Generator Line Contactor for Generator 1/2/3
- GLSC: Galley Load Shed Contactor
- LS 1/2:Load Shed 1/2

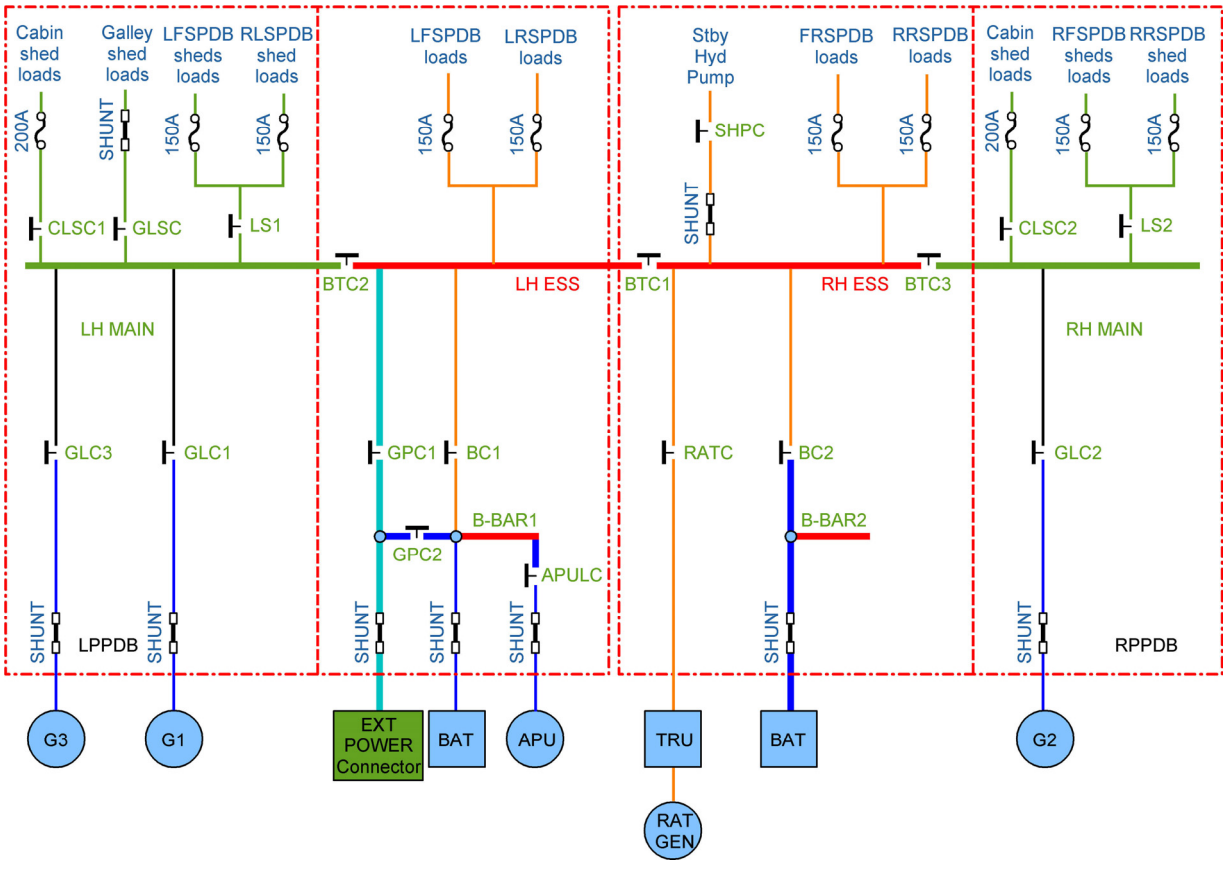


FIGURE 02-24-15-01 - PPDB DETAILED CONTENT

ENGINE-DRIVEN GENERATOR

Three Generator Control Units (GCU) provide current and voltage control and protection for their associated generator:

- Control: the GCU regulates the voltage at 28.5 VDC. It monitors the output current in order to comply with peak power protection (above 500 A continuous rating). It also provides generator output control in order to balance the voltage between several generators, when connected in parallel,
- Protection: the GCU provides the PDCU with an overcurrent detection signal in order to start the fault isolation sequence,

The GCU automatically disconnects its associated generator when the electric load limit is reached or in case of an over-voltage or abnormal condition.

APU GENERATOR

The APU Generator Control Unit (GCU) provides current and voltage control and protection for its associated generator:

- Control: the GCU regulates the voltage at 28.5 VDC and monitors the output current to 400 A, with a maximum of 600 A for 2 minutes. It also provides generator output control in order to balance the voltage between several generators, when connected in parallel,
- Protection: the GCU automatically disconnects the generator when the electric load limit is reached or in case of an over-voltage.

RAM AIR TURBINE

When the airplane speed is low, the generator output voltage is reduced, and batteries start providing power. In this manner both the RAT and batteries power all the required airplane loads during this phase.

The RAT is fully operative (400A rating) until airplane speed is above 140 kt.

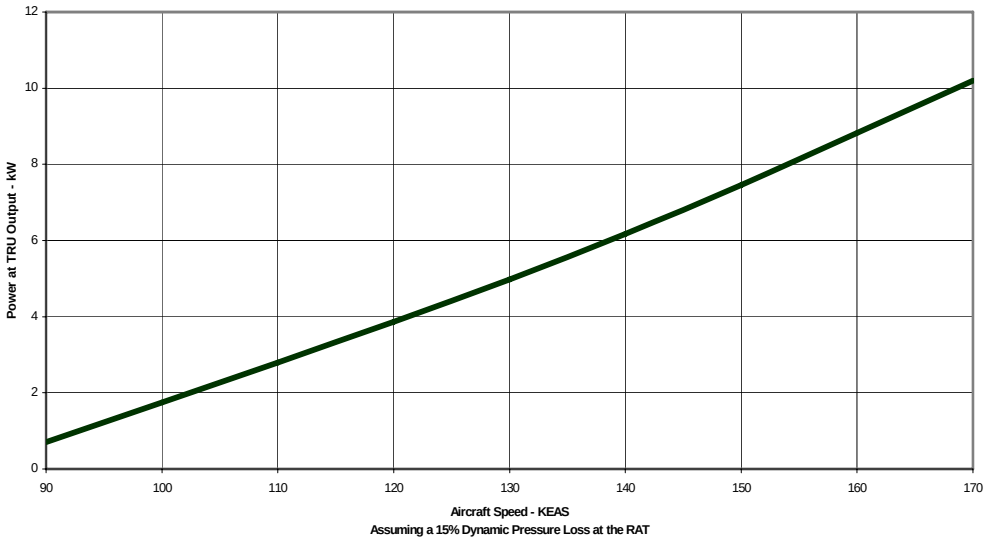


FIGURE 02-24-15-02 - RAT ELECTRICAL OUTPUT DEPENDING ON AIRPLANE SPEED

The RAT system includes seven separate components:

- The Ram Air Turbine, which houses the generator and its heater,
- The Generator Control Unit (GCU),
- The Transformer Rectifier Unit (TRU),
- The deployment actuator,
- The re-stow pump (ground operation only),
- The up lock,
- The manual release handle.

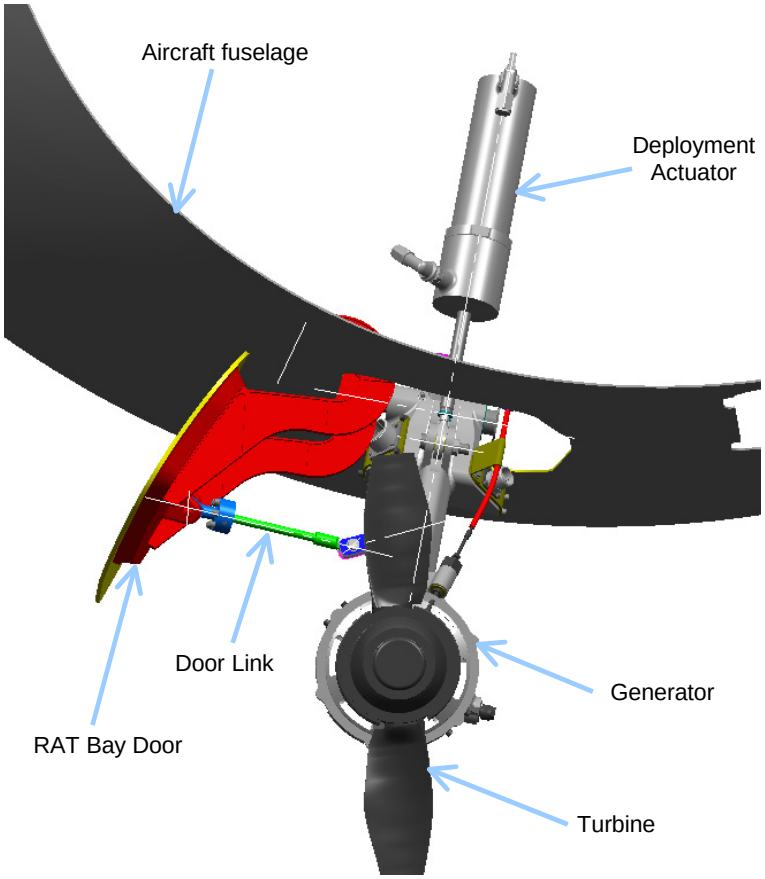


FIGURE 02-24-15-03 - RAT IN THE DEPLOYED POSITION

The RAT deployment actuator is a spring loaded shock absorber actuator that mechanically deploys the RAT. The deployment is activated by the manual release handle positioned in the floor on the left side of the copilot's seat rail.

DISTRIBUTION DETAILED DESCRIPTION

Following figure shows the detailed description of distribution from the PPDB to the SPDB and other loads.

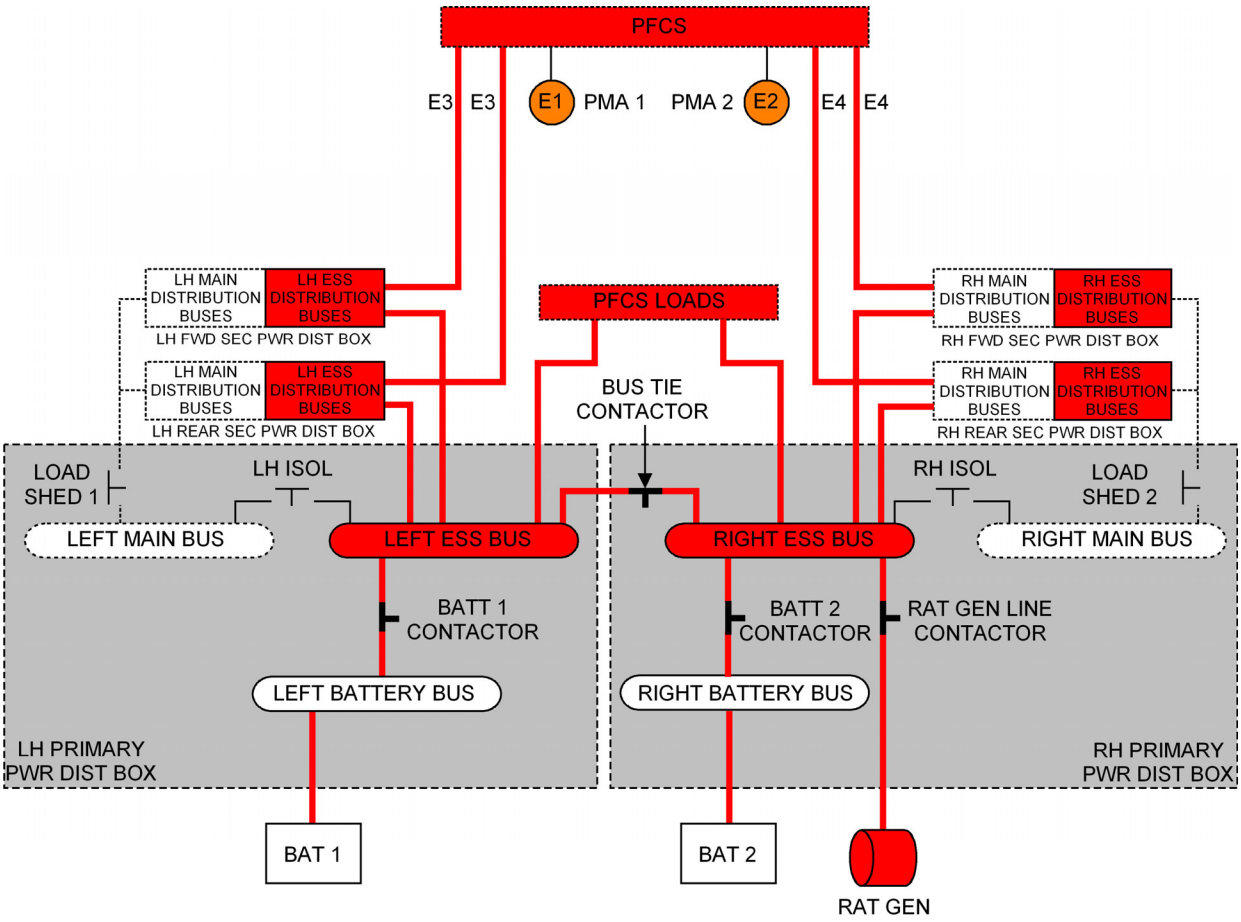


FIGURE 02-24-15-04 - DISTRIBUTION DETAILED DESCRIPTION

DISTRIBUTION DURING AIRPLANE POWER UP

The following diagrams show the position of the contactors during the various normal ground operations.

INITIAL CONDITIONS

All contactors are open.

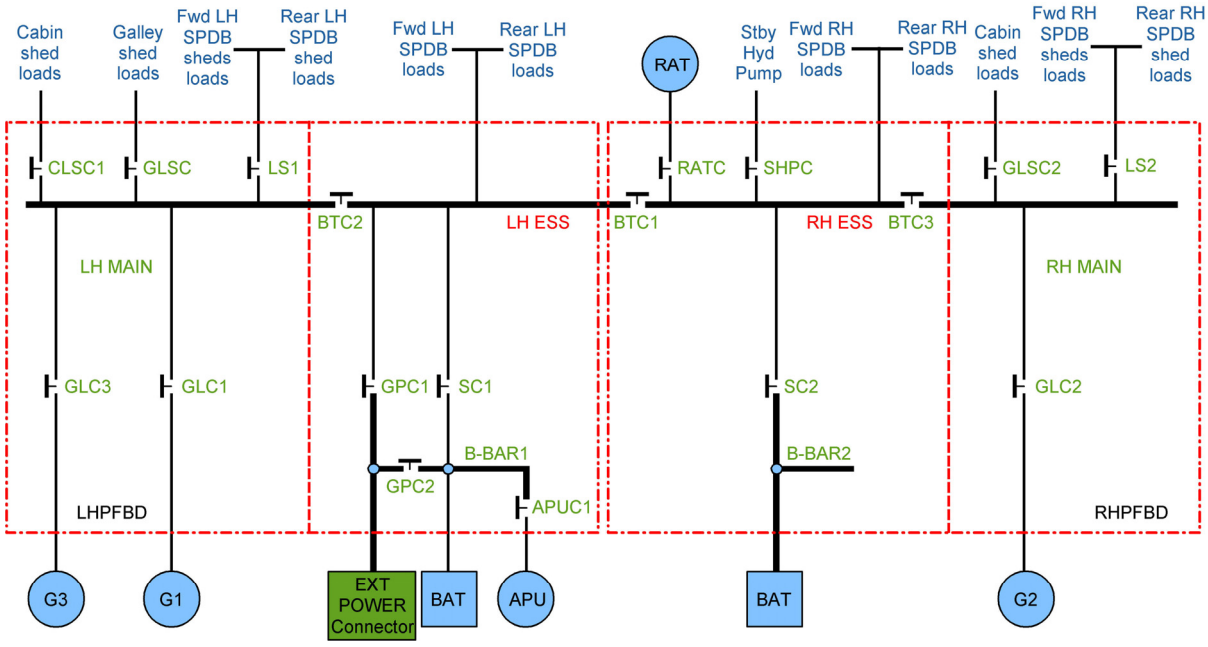


FIGURE 02-24-15-05 - DISTRIBUTION - INITIAL CONDITIONS

BATTERY MASTERS SELECTED

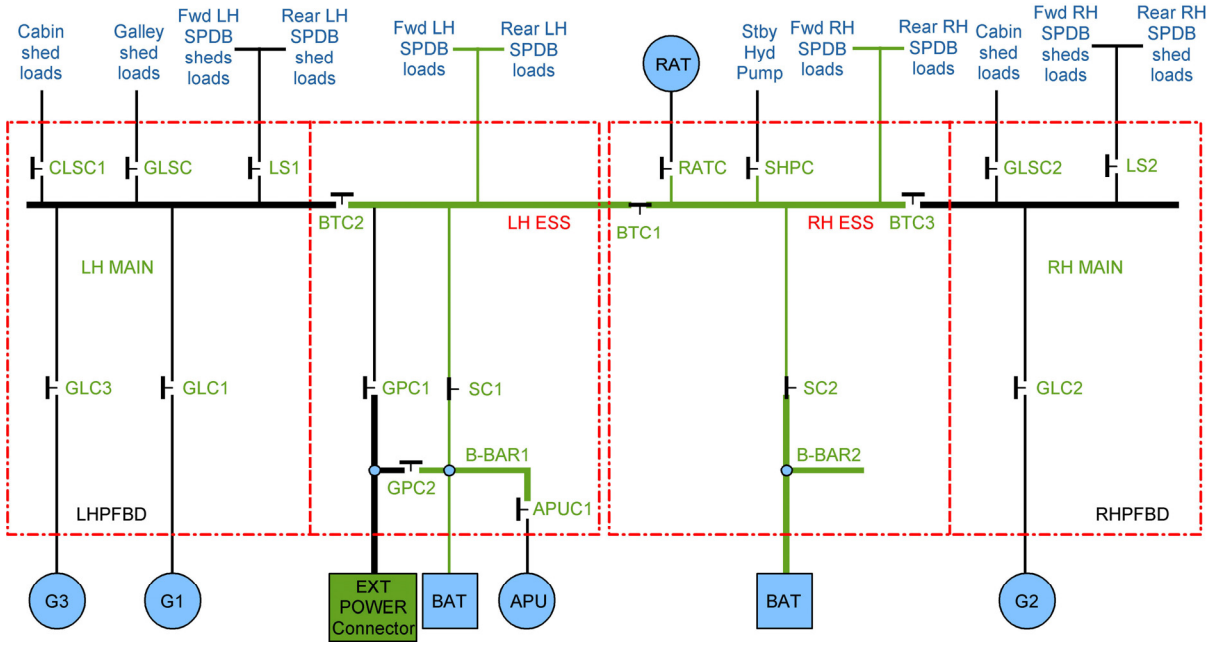


FIGURE 02-24-15-06 - DISTRIBUTION - BATTERY MASTERS SELECTED

EXTERNAL POWER CONNECTED

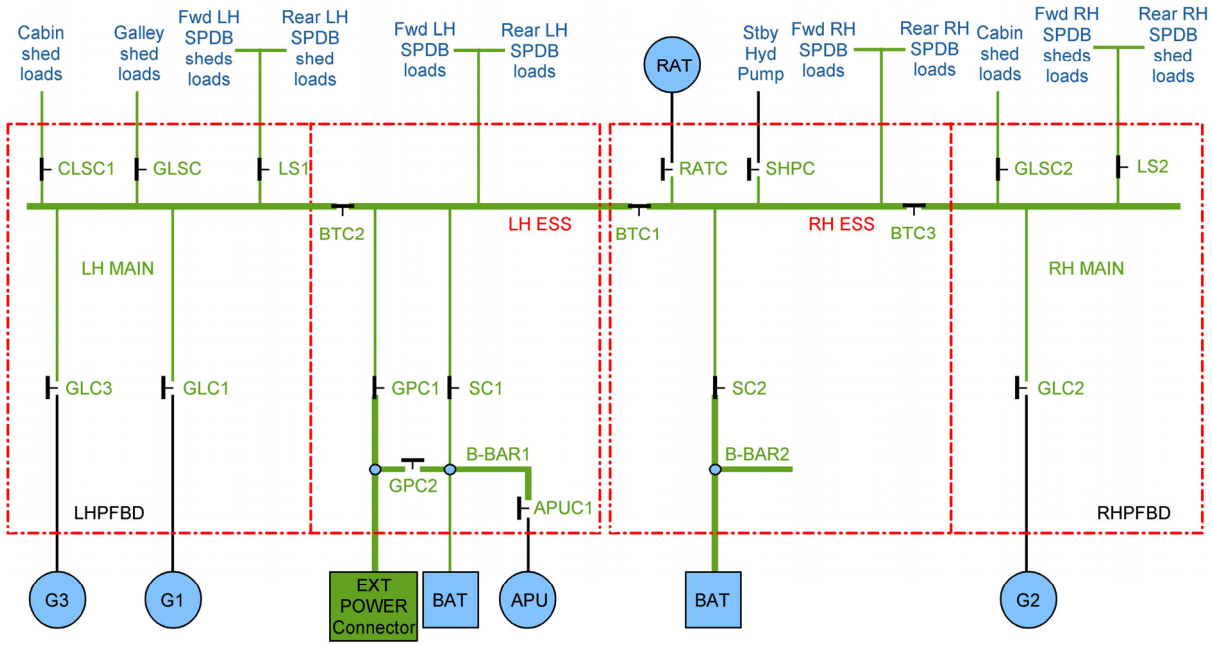


FIGURE 02-24-15-07 - DISTRIBUTION - EXTERNAL POWER CONNECTED

APU START WITHOUT EXTERNAL POWER

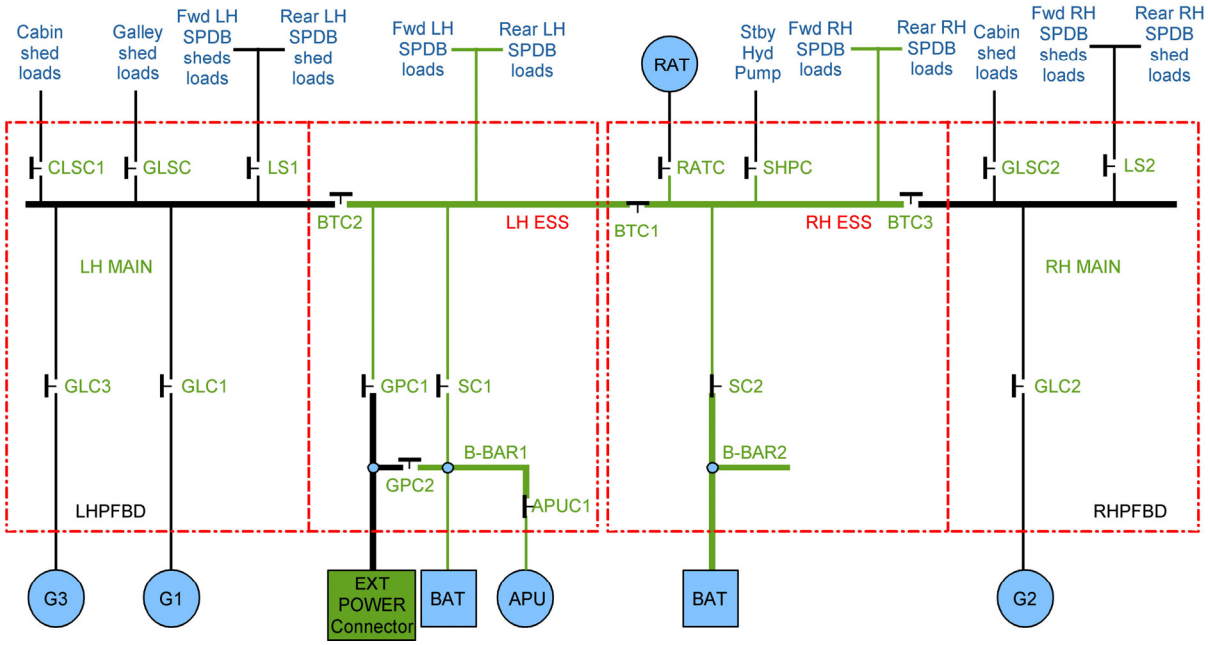


FIGURE 02-24-15-08 - DISTRIBUTION - APU START WITHOUT EXTERNAL POWER

APU START WITH EXTERNAL POWER

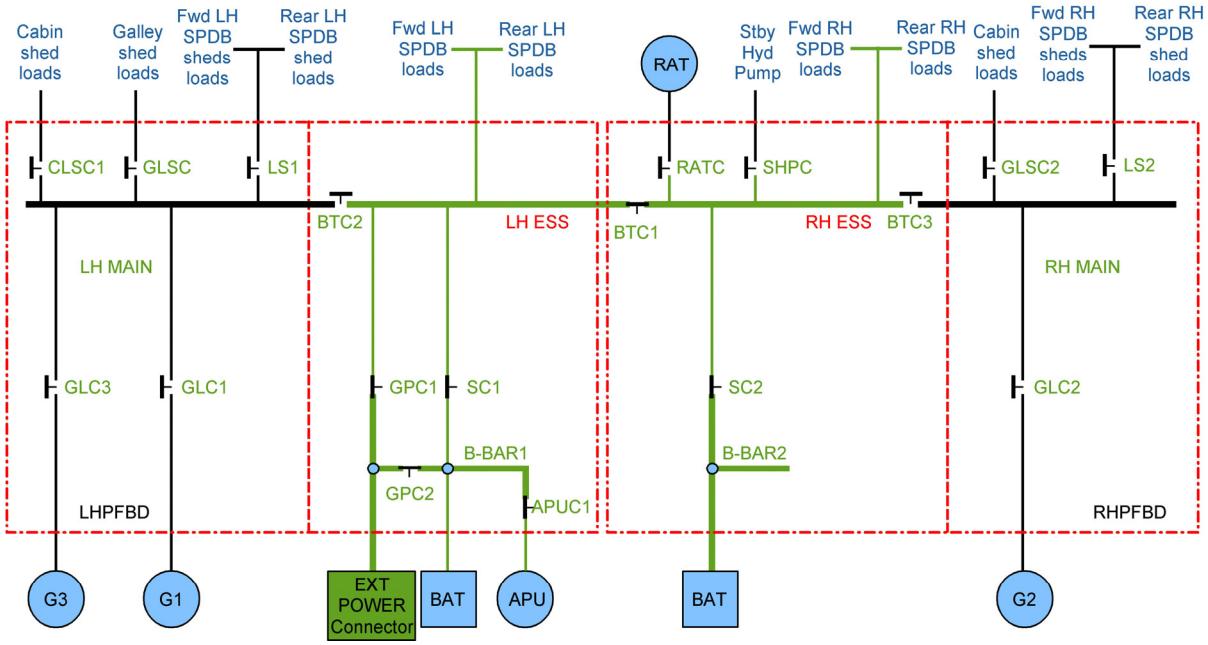


FIGURE 02-24-15-09 - DISTRIBUTION - APU START WITH EXTERNAL POWER

APU RUNNING WITH GROUND POWER UNIT ON LINE

GPU has priority over APU.

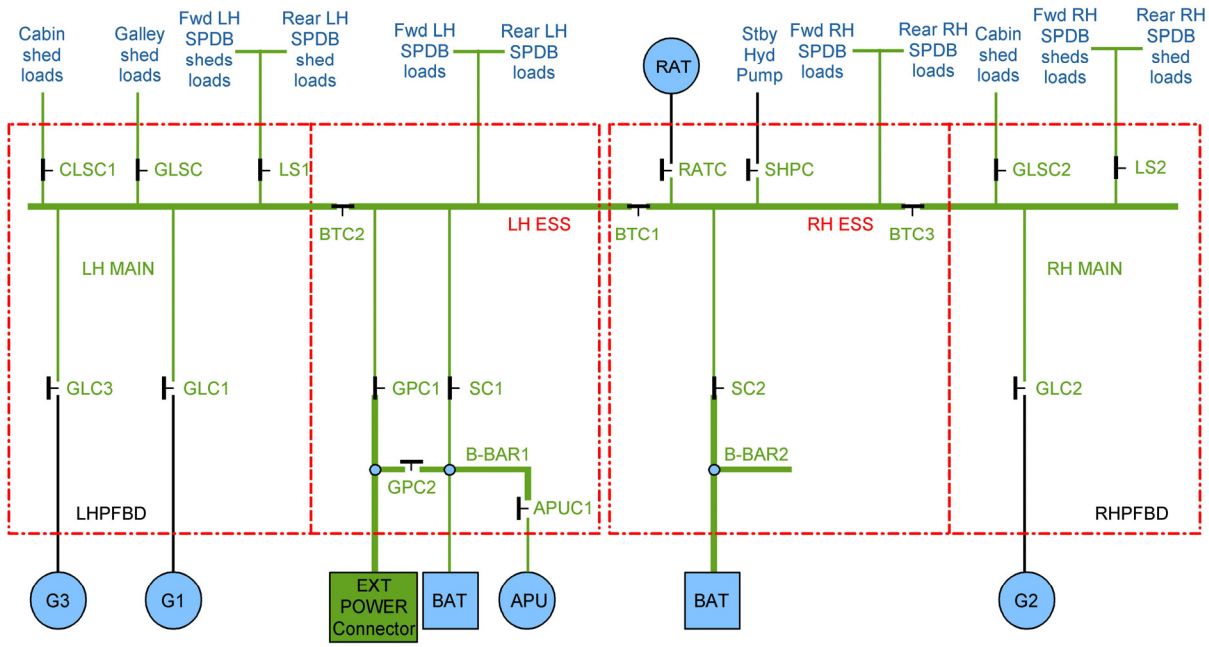


FIGURE 02-24-15-10 - DISTRIBUTION - APU ON LINE WITH GROUND POWER UNIT

APU GENERATOR ON LINE / GROUND POWER UNIT OFF

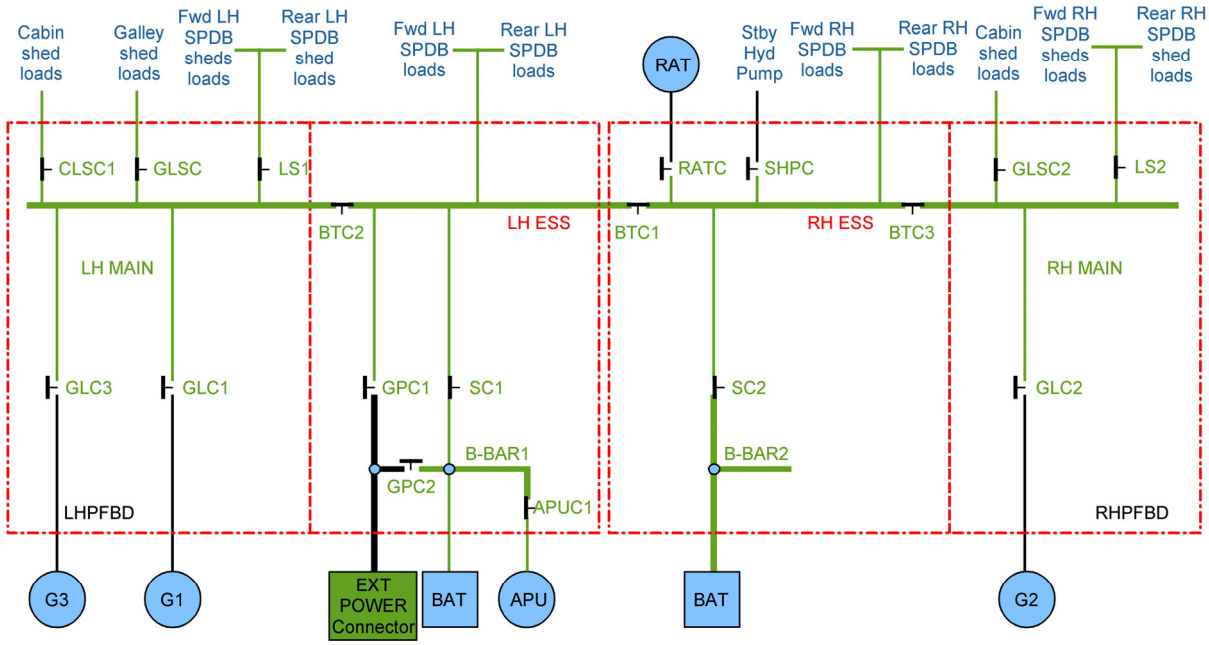


FIGURE 02-24-15-11 - DISTRIBUTION - APU ON LINE WITHOUT GROUND POWER UNIT

CONTROL

Crew has control on the electrical system via:

- The DC SUPPLY Panel on the overhead panel,
- Two switches on the Emergency Panel (aft end of the pedestal) for RAT AUTO and ELEC RH ESS,
- The RAT Manual Release Handle (right side of the pedestal),
- TEST synoptic page for the RAT test,
- The Fire Control Panel in case of engine fire, to confirm generator disconnection,
- The Maintenance panel for "ground servicing bus",
- The C/B STATUS sub-page page of the ELECtrical synoptic page, on ground, for changing electronic CB status.

DC SUPPLY CONTROL PANEL

Pilots can manually control the Electrical System via the switches in the DC SUPPLY overhead panel.

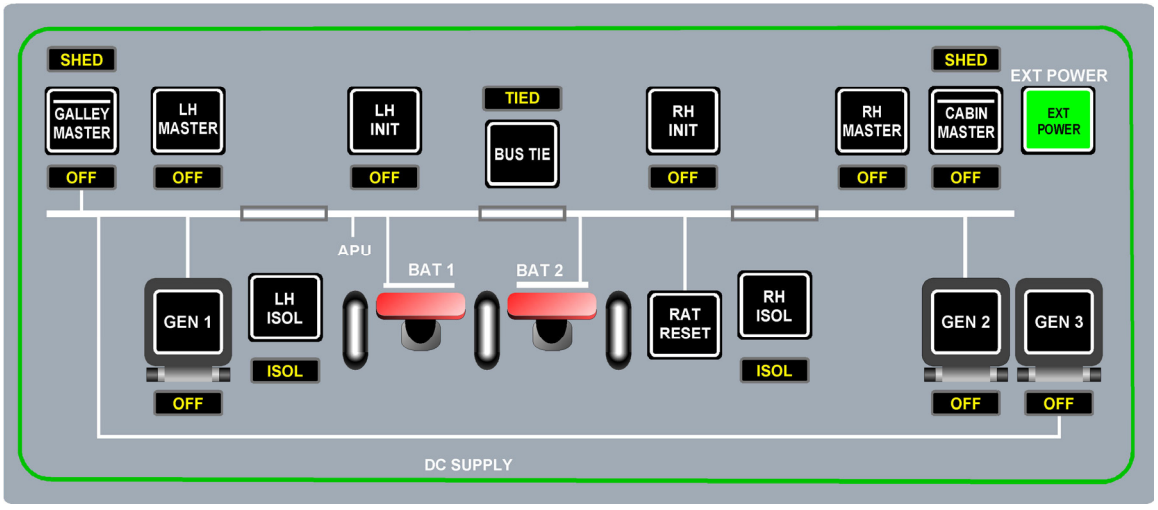


FIGURE 02-24-20-00 - DC SUPPLY SECTION OF THE OVERHEAD PANEL

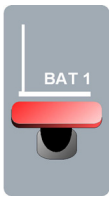
Synthetic table

<table>
<tr><th>CONTROL</th><th>FUNCTION</th><th>TO ACTIVATE
TO DEACTIVATE</th><th>SYNOPTIC</th></tr>
<tr><td rowspan="3"> 


</td><td rowspan="3">- GEN 1 connects generator 1 to the LH MAIN bus
- GEN 2 connects generator 2 to the RH MAIN bus
- GEN 3 connects generator 3 to the LH MAIN bus</td><td rowspan="2"> 

Auto: allow GCU to automatically control the corresponding generator.</td><td>Generator
is connected
 
</td></tr>
<tr><td>Generator is not connected conformaly to normal operation:
- Engine is stopped.
 
</td></tr>
<tr><td> 

OFF: allow to manually disconnect the corresponding generator</td><td>Generator is disconnected:
- Commanded by the crewmembers.
 
</td></tr>
<tr><td>Generator is not connected due to a malfunction, while engine is running.
 
</td></tr>
</table>

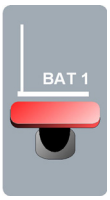
<table>
<tr><th>CONTROL</th><th>FUNCTION</th><th>TO ACTIVATE
TO DEACTIVATE</th><th>SYNOPTIC</th></tr>
<tr><td rowspan="4"> 

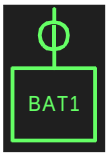
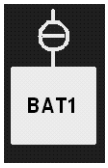
Two-position trip magnetic switch

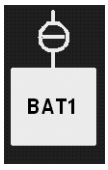
 

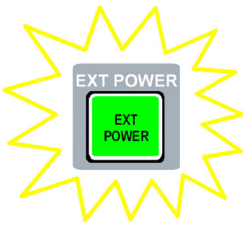
Two-position trip magnetic switch</td><td rowspan="4">- BAT 1 connects battery 1 bus to the LH ESS bus and contactor is controlled by PDCU

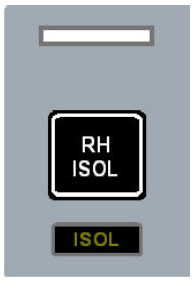
NOTE
Battery 1 supplies the battery bus whatever battery switch position.

- BAT 2 connects battery 2 bus to the RH ESS bus and contactor is controlled by PDCU
- BAT 1 or 2 trips automatically to down position when the system detects an anomaly (high reverse current)
- BAT 1 and 2 act as reset switches when the fault is cleared</td><td rowspan="3"> 

BAT1 Connected and controlled by PDCU</td><td>BAT1 is connected (except APU starting)
 
</td></tr>
<tr><td>BAT1 is disconnected during APU starting
 
</td></tr>
<tr><td>Abnormal situation: BAT1 is disconnected due to a malfunction
 
</td></tr>
<tr><td rowspan="2"> 

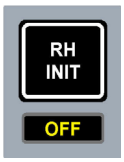
BAT1 Disconnected</td><td>BAT1 is disconnected
 
</td></tr>
<tr><td>Abnormal situation: BAT1 is connected while it should be disconnected
 
</td></tr>
</table>

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
 light pushbutton	On ground only: allows external power to supply LH ESS bus	 Push On (System feedback)	On: airplane powered by external power. 
			Abnormal operation: airplane powered by external power and fault conditions or current < 400 A 
		 Flash	Abnormal operation: extenal power is connected and at least one engine generator is connected. 
		 Push Off	Off: airplane not powered by external power. 

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	Ties up LH ESS and RH ESS buses	 Push unlighted auto	Buses normally untied 
			Buses abnormally tied 
		 Push TIED	Buses tied as commanded 
			Buses abnormally untied 
 	Isolates LH / RH MAIN buses from respective LH / RH ESS buses	 Push unlighted auto	Buses normally tied 
			Buses abnormally isolated 
		 Push ISOL	Buses isolated as commanded 
			Buses abnormally tied 

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	- Sheds cabin optional equipment load from the LH MAIN and RH MAIN buses o Short push: alternates between "Auto" and "OFF" o Long push: SHED - Auto: contactor is connected and controlled by PDCU, closed if condition is acceptable. - OFF: contactor is disconnected and also GALLEY one. - SHED: allows to recover some pre determined loads after automatic shed.	Auto  SHED  OFF 	No specific indication on the ELEC synoptic
	- Sheds galley equipment load from the LH bus: o Short push: alternates between "Auto" and "OFF" o Long push: SHED - Auto: contactor is connected and controlled by PDCU, closed if condition is acceptable. - OFF: contactor is disconnected - SHED: allows to recover some pre determined loads after automatic shed.	Auto  SHED  OFF 	No specific indication on the ELEC synoptic

➢ *For further information on "Long push pushbuttons", refer to CODDE 1 chapter 1*

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
	Supplies power to LH MAIN and LH ESS buses avionics equipment	Push on (connected)  Push OFF (not connected) 	No specific indication on the ELEC synoptic
	Supplies power to RH MAIN bus equipment	Push on (connected)  Push OFF (not connected) 	No specific indication on the ELEC synoptic
	Supplies power to LH ESS bus equipment	Push on (connected)  Push OFF (not connected) 	No specific indication on the ELEC synoptic
	Supplies power to RH ESS bus equipment	Push on (connected)  Push OFF (not connected) 	No specific indication on the ELEC synoptic

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
 momentary pushbutton	Resets RAT GEN in case of disconnection due to over-current	No indication	

EMERGENCY CONTROL PANEL

FIGURE 02-24-20-01 - EMERGENCY CONTROL PANEL, ON PEDESTAL

Synthetic table

CONTROL	FUNCTION	TO ACTIVATE TO DEACTIVATE	SYNOPTIC
ELEC RH ESS pushbutton on Emergency Panel: 	- Isolates RH ESS bus and forces the connection of BAT 2	Normal off  Push ISOL 	No specific indication on the ELEC synoptic.
RAT AUTO pushbutton on Emergency Panel: 	- prohibites the automatic deployment of RAT	Normal off  Push INHIBIT 	No specific indication on the ELEC synoptic. Advisory CAS message is displayed: **ELEC: RAT AUTO INHIBIT**

RAT MANUAL RELEASE HANDLE

The release handle used to manually deploy the RAT is located on the cockpit floor to the left side of the copilot's seat.

The release handle is protected from inadvertent release by a cover.

FIGURE 02-24-20-02 - MANUAL RELEASE COVER AND MANUAL RELEASE HANDLE

RAT TEST

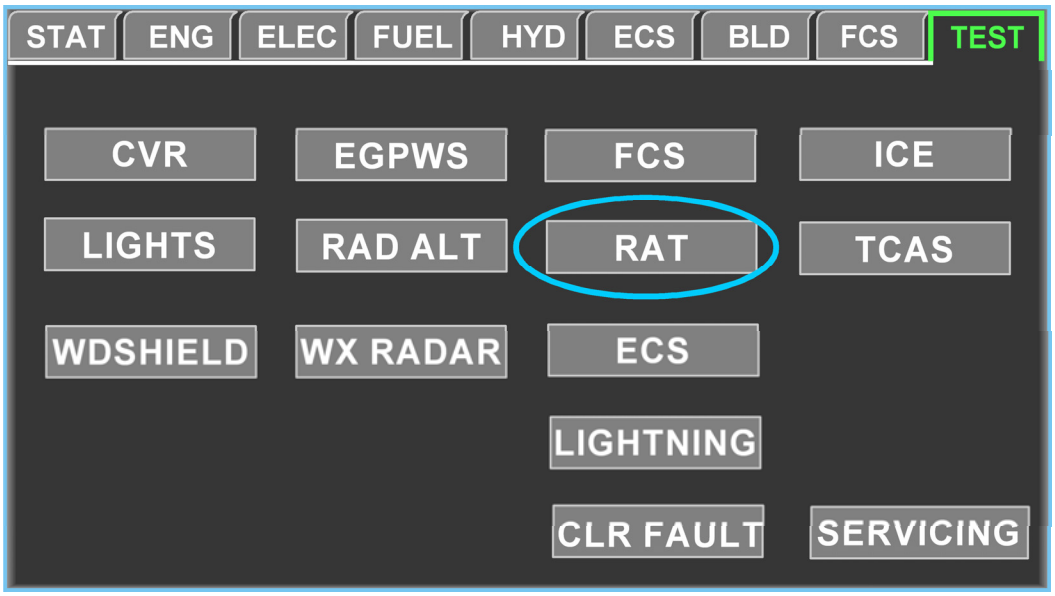


FIGURE 02-24-20-03 – RAT TEST

TEST synoptic page provides access to:

- RAT test: checks RAT GCU, generator heating and coupling contactor.

Placing the CCD cursor on the respective soft key and keeping the <ENTER> button pressed triggers the respective test.

An advisory ELEC: RAT TEST IN PROGRESS CAS message is displayed when the RAT test is progressing.

FIRE CONTROL PANEL

The generators will be confirmed as disconnected when the corresponding engine FIRE guarded pushbuttons on the Fire Control Panel is depressed.

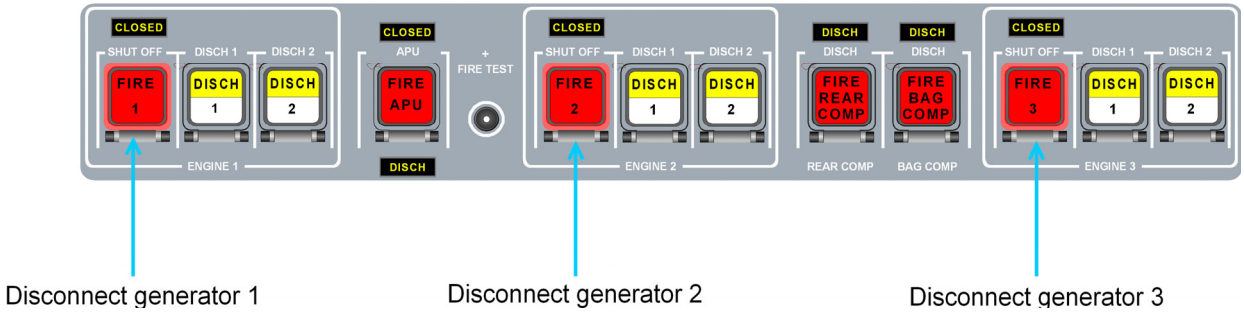


FIGURE 02-24-20-04 – GENERATOR DISCONNECTION ON FIRE CONTROL PANEL INDICATIONS

Indications related to the Electrical System configuration and status are displayed in:

- "DC SUPPLY" Panel (on the overhead panel),
- The ELECtrical System Synoptic and subpage "Circuit Breaker",
- The ENG-CAS window for CAS messages ,
- The STATus synoptic / FAULT tab for fault messages.

"DC SUPPLY" PANEL

NOTE

The DC supply panel provides system feedback indications for EXTernal POWER connection, bus tied or isolated, and Generator contactor "OFF".

ELEC SYNOPTIC PAGE

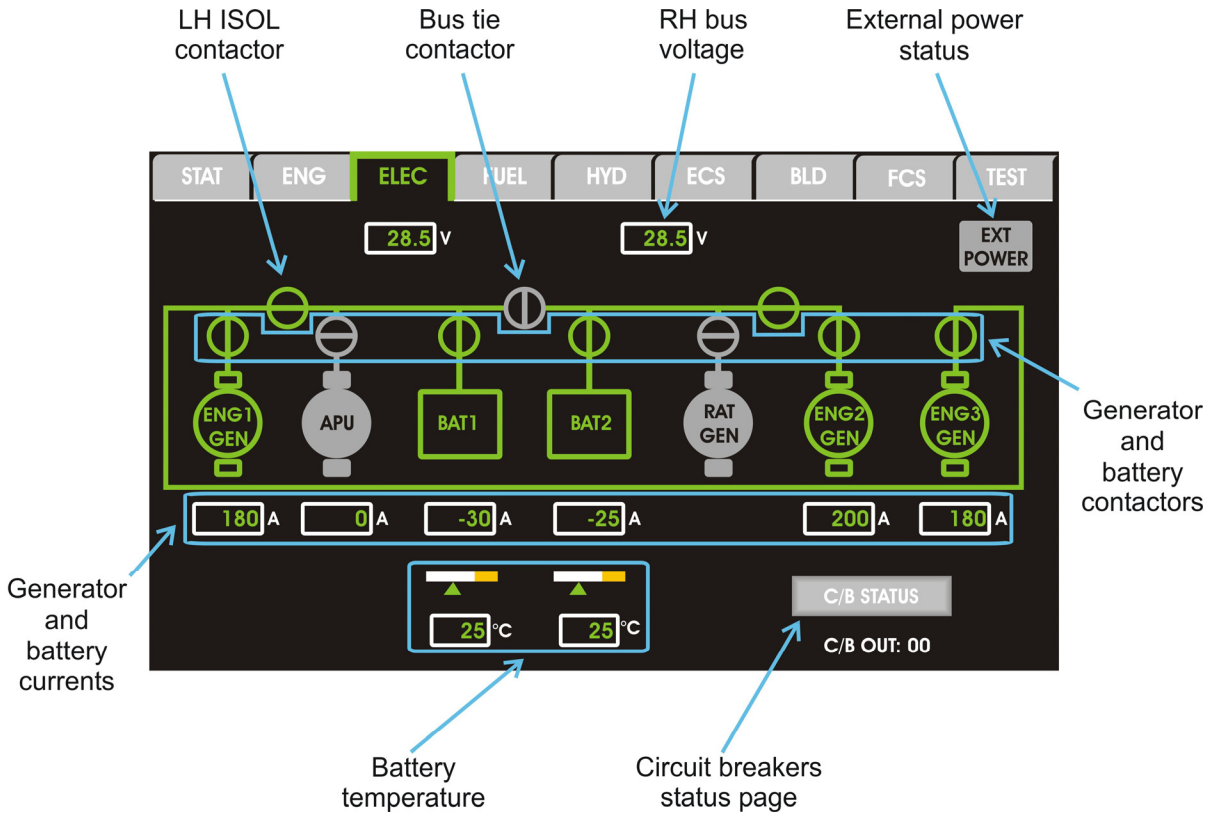


FIGURE 02-24-20-05 - ELEC SYNOPTIC PAGE

Battery Ammeter

For each battery, current indication is given by a digital readout and colored in amber above 330A.

NOTE

A negative current designates a charging current.

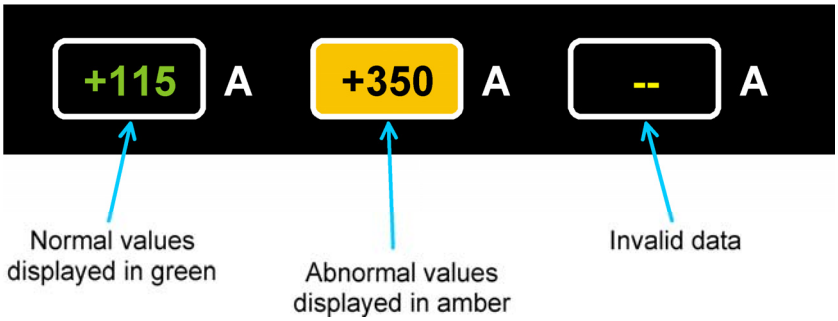


FIGURE 02-24-20-06 BATTERY AMMETER

Battery Temperature Indication

For each battery, temperature indication is given by a pointer position on a temperature tape and by a digital readout.

The scale is colored in white below 56°C, in amber above 56°C.

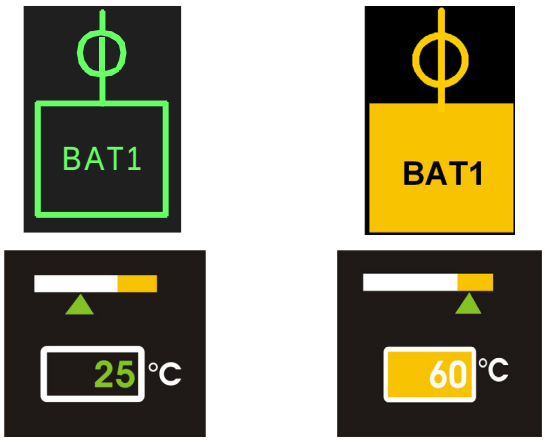


FIGURE 02-24-20-07 - BATTERY TEMPERATURE

DC Generator Ammeter

Current indication is displayed by a digital readout for the three engine-driven generators. Indications are colored in amber:

- On ground, above 375 A,
- In flight, above 500 A.
- Whichever condition below -15 A

For the APU generator, the ammeter is displayed in grey when the APU MASTER pushbutton is ON. Then, above 99% APU N1, a colored indication is displayed, in green or in amber above 400 A.

NOTE

For any generator or battery, 0 A is displayed on synoptic ammeters when actual current is between -10 A and +10 A

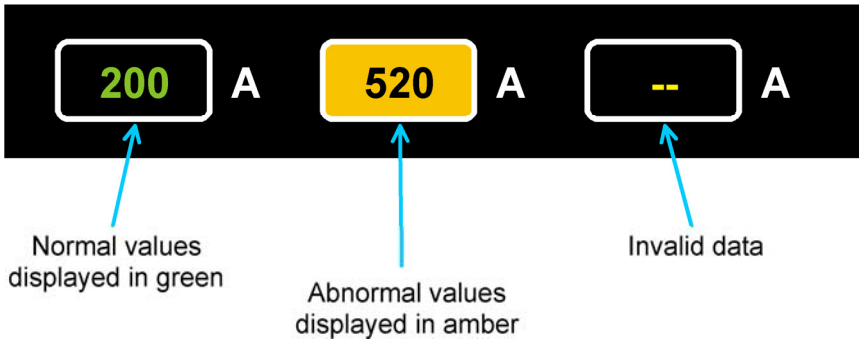


FIGURE 02-24-20-08 DC GENERATOR AMMETER

Buses Voltmeter

LH ESS, RH ESS, LH MAIN and RH MAIN buses can be individually monitored through four digital voltmeters displayed in the ELEC synoptic page when all buses are untied / isolated.

In normal operation, LH ISOL for LH side and RH ISOL for RH side closed, only two digital voltmeters are displayed, representing current in LH and RH buses.

When a generator supplies the bus, the digital readout is colored in amber below 25 V and above 30 V. This range is different in case of RAT operation.

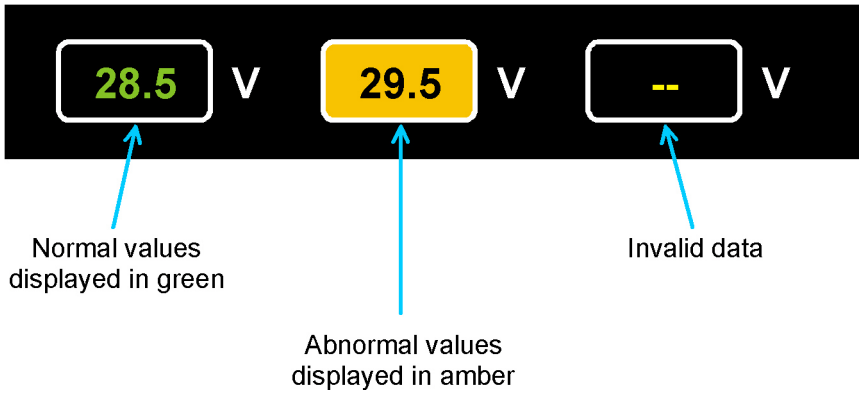


FIGURE 02-24-20-09 - BUSES VOLTMETER

STATUS SYNOPTIC PAGE

At the top of the STATus page, following information on the electrical system are summarized:

- LH and RH buses voltages,
- Generators and batteries amperage.

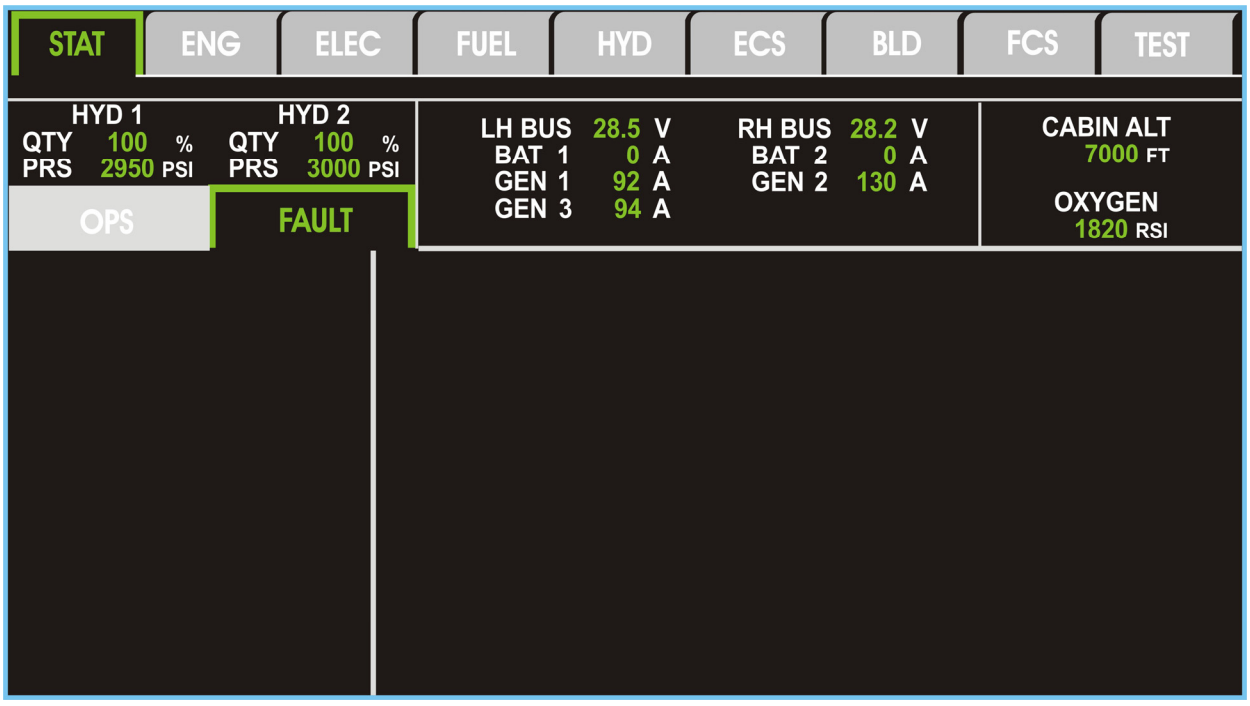


FIGURE 02-24-20-10 - STATUS/ FAULT SYNOPTIC PAGE

CIRCUIT BREAKERS STATUS PAGE

Circuit breakers status page can be accessed through the C/B STATUS soft key on the ELEC synoptic page.

Number of CB /SSPS tripped is displayed in ELEC synoptic page below the C/B STATUS soft key:

- In white if the tripped status number is zero,
- In amber reverse video text if at least one CB / SSPC is tripped.

Circuit breakers status is filtered and displayed by airplane systems (e.g. AIR CONDITIONING, as figured below).

When an airplane system is selected using the SELECTED SYSTEM pull down menu soft key on the left hand side of the page, the system name is displayed on pull down menu button. The pull down menu button turn green to indicate selected for display. An amber background behind the ATA number indicates at least one circuit breaker or SSPC is in the OUT position

In the case of AVIONICS or COM NAV is the selected system, breakers can be also filtered by avionics master switch: LH / RH AVION MASTER, LH / RH AVION INIT.

The CB / SSPC used for that airplane system is listed on the right hand side of the page with the ability to scroll through many items via the Dual Concentric Knob on the CCD.

Breaker status can be:

- IN: circuit closed,
- OUT: circuit open,
- LOCK: circuit manually forced opened and locked (on ground only, for maintenance or dispatch purpose).

The CHANGE SSPC STATE soft keys are not usable in flight (greyed out). The description of the controls is described in sub-section 02-24-40.

FIGURE 02-24-20-11 – AIR CONDITIONING BREAKERS STATUS PAGE ON GROUND ONLY

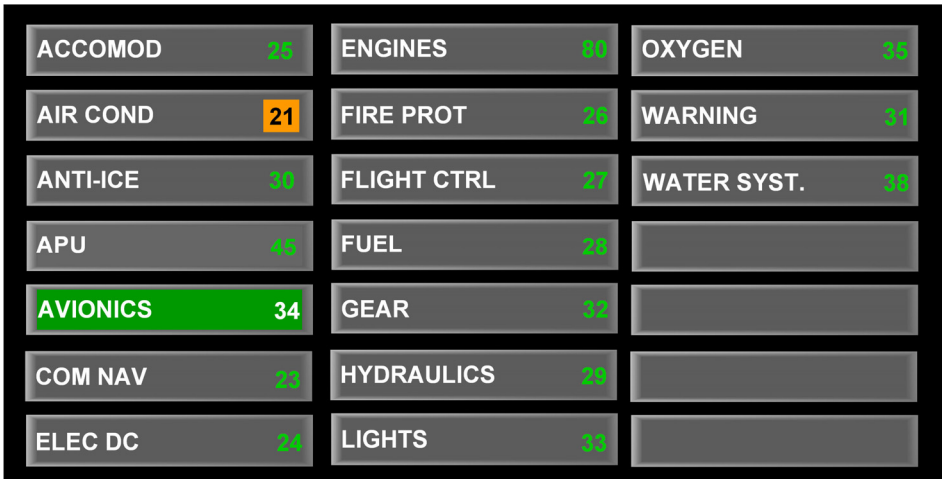


FIGURE 02-24-20-12 – SELECTED SYSTEM PULL DOWN MENU

FIGURE 02-24-20-13 – RH AVION MASTER BREAKERS STATUS PAGE

CONTROLS

The avionics equipments are connected to the MAIN and ESS buses through the master pushbuttons. Power supply of each avionics equipment is provided in following table.

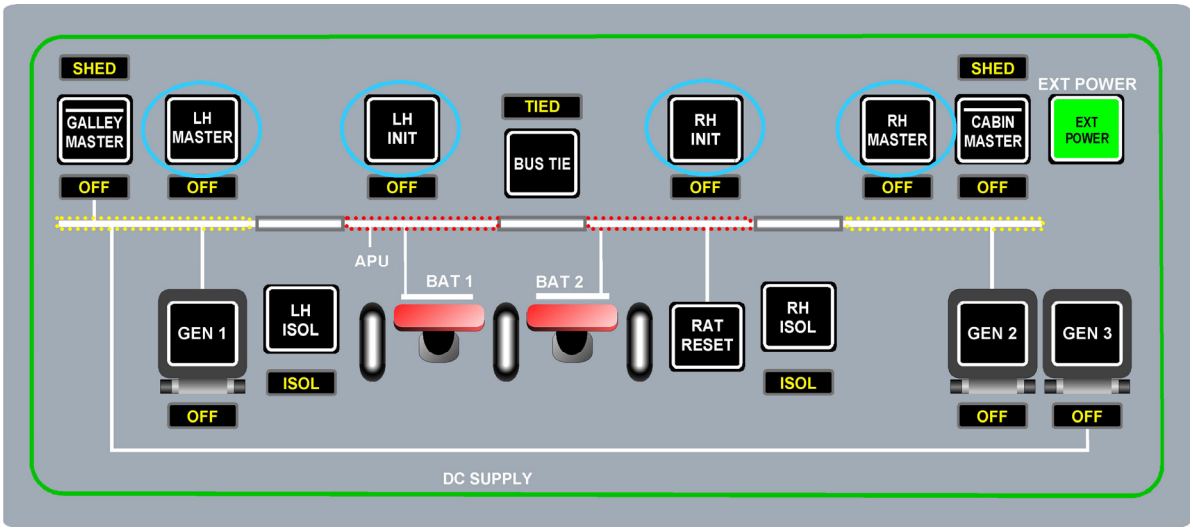


FIGURE 02-24-25-00 - DC SUPPLY SECTION OF THE OVERHEAD PANEL

AVIONICS LOADS				
				
LH ESS BUS	**LH MAIN BUS**	**LH ESS BUS**	**RH ESS BUS**	**RH MAIN BUS**
ADF 1 ATC 1 VIDL-G 1	Audio Panel 3 Data Loader DME 1 HUD MAU 2B Radio Alt. 1 MRC NIM 1 RH CCD Chan. A SATAFIS TCAS VHF3	LH CCD Chan. A LH GP MAU 1A	MAU 2A RH CCD Chan. B	ADF 2 ATC 2 Audio Panel 2 DME 2 LH CCD Chan. B LSS MAU 1B Radio Alt. 2 MRC NIM 2 RH MKB RH GP VHF 2 VIDL-G 2

NOTE

In case LH ESS bus power is lost, avionics equipment connected through LH INIT pushbutton is fed by LH MAIN bus.

SYSTEM MONITORING

Monitoring of the following parameters is provided by the system:

- Generator load and voltage,
- Battery voltage, recharge current and temperature,
- Bus voltage.

➢ *Refer to CODDE 2 for a complete list of CAS messages.*

ACTIVE PROTECTIONS

Active protections include:

- Load shedding of some loads when electrical power sources can not supply all airplane loads.
- Generator under/over voltage, current output limitation through automatic disconnection of the corresponding generator to the bus by the GCU.
- A shear shaft in the generator to prevent damage to the accessory gearbox in case of generator seizure. A damper in the generator shaft prevents vibration.
- Bus short-circuit (or undervoltage) through automatic isolation of the bus by the corresponding PDCU.
- Fuses in the PPDB to protect SPDB feeder cables,
- Conventional mechanical Circuit Breakers in the PPDB,
- Conventional mechanical Circuit breakers and Electronic Circuit Breaker (SSPC) in the SPDB.
- Static dischargers (12) evacuate static currents and prevent severe damages in case of lightning attachments. Static dischargers are installed on the trailing edge of each wing and horizontal stabilizer.

LOAD SHEDDING LOGIC

In flight, main load-shedding logics are:

- PFCS loads: never load shedded,
- In case of one generator overload: cabin loads are load-shedded,
- If one generator fails: RH cabin loads are load-shedded until RH battery is sufficiently charged,
- If two generators fail: Cabin and Galley loads are load-shedded,
- If three generators fail: SPDB loads and Cabin and Galley loads are load-shedded.

On ground, the auto load-shed system is disabled, allowing normal operation of all cabin facilities: with only one generator there is not automatically load shedding of cabin and galley load.

ELECTRONIC CIRCUIT BREAKERS (SSPC)

The Solid State Power Controller (SSPC) modules are designed to provide overload protection in the same manner as a conventional thermal circuit breaker. Their overcurrent protection logic is however not only based on a predetermined threshold, but on various thresholds which depend on the duration of the overcurrent.

Their status can be modified by software from the cockpit or by connecting to the SPDB.

ACTIVE PROTECTIONS

ENGINE DRIVEN GENERATOR & APU GENERATOR (GCU) PROTECTION

The engine-driven generators and the APU are each monitored by a Generator Control Unit (GCU).

Main protection functions are:

- Over / under voltage,
- Differential voltage,
- Reverse current,
- Overcurrent,
- Dearing sense,
- Underspeed.

When a generator is isolated, the corresponding OFF indication is lighted on the overhead panel and a CAS message is displayed.

BATTERIES PROTECTION

The batteries are protected against excessive charging (overcharged / overheated) by a trip magnetic switch, which opens and disconnects the battery.

In that case, the BAT 1 and/or BAT 2 magnetic switches trip off, and a CAS message is displayed.

Battery reverse current, overcharging and fault protection is provided in each PDCU.

RAM AIR TURBINE GENERATOR (GCU) PROTECTION

The Ram Air Turbine (RAT) is monitored by a Generator Control Unit (GCU).

Main protection functions are:

- Over/under voltage,
- Fault protection,
- Under-frequency protection.

GROUND POWER SOURCE CONTROL & PROTECTION

The PDCU allow connection of external power source to the aircraft distribution system if voltage and current are within limits.

The PDCU automatically disconnects ground power to the aircraft distribution system if voltage or current are outside the limits range by opening GPC 1 (see figure 02-24-15-07) and by tripping the ON-OFF toggle switch in the ground power.

GROUND POWER CONNECTOR

The ground power receptacle located behind the ground power panel on the RH side of the lower fuselage enables a 28VDC external ground power unit to be connected to the airplane.

The connection of external power to the distribution system is controlled from the Overhead Panel.

A switched circuit breaker located inside the ground power panel adjacent to the ground power receptacle provides protection and will automatically trip if power quality is not acceptable.

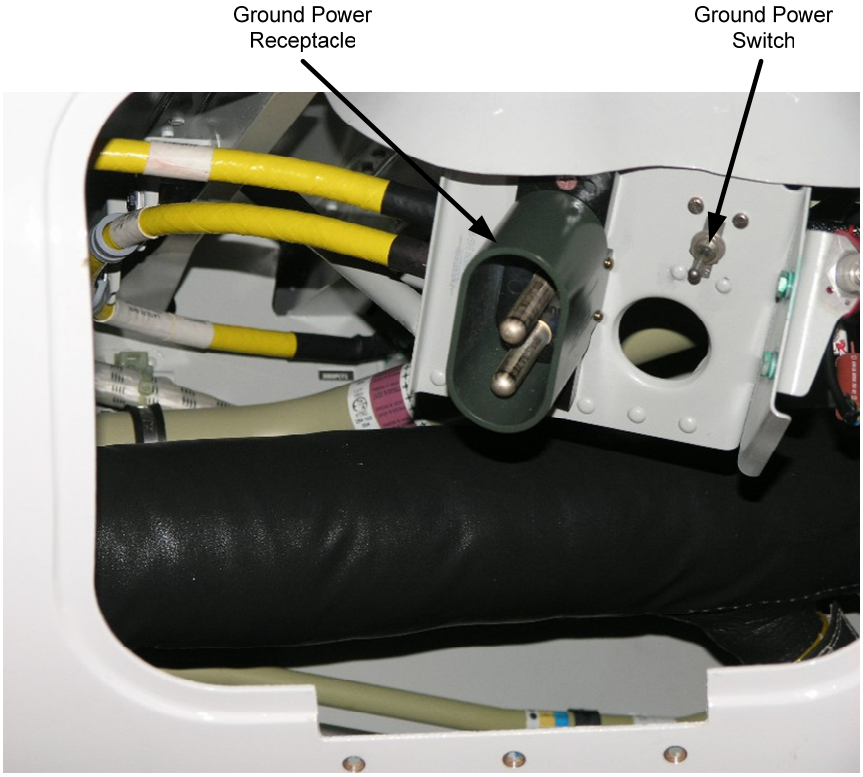


FIGURE 02-24-40-00 - GROUND POWER RECEPTACLE

The normal sequence of events for connecting ground power to the airplane is to open the ground power panel and connector the 28 volt DC plug into the power receptacle, select the ground power ON/OFF toggle action switch to ON, enter the flight deck and select EXT POWER pushbutton on the OP.

➢ *Refer to Ground Servicing manual.*

GROUND SERVICE BUS

The Ground Service Bus (GSB) allows to energize some of the airplane systems, in purpose to check or test them.
The checks or tests are done through the servicing page accessible through the TEST synoptic page.
To active the GSB the batteries must be set to the down position (off) and the
GND SERVICING switch located on the maintenance panel must be set to the upper position.

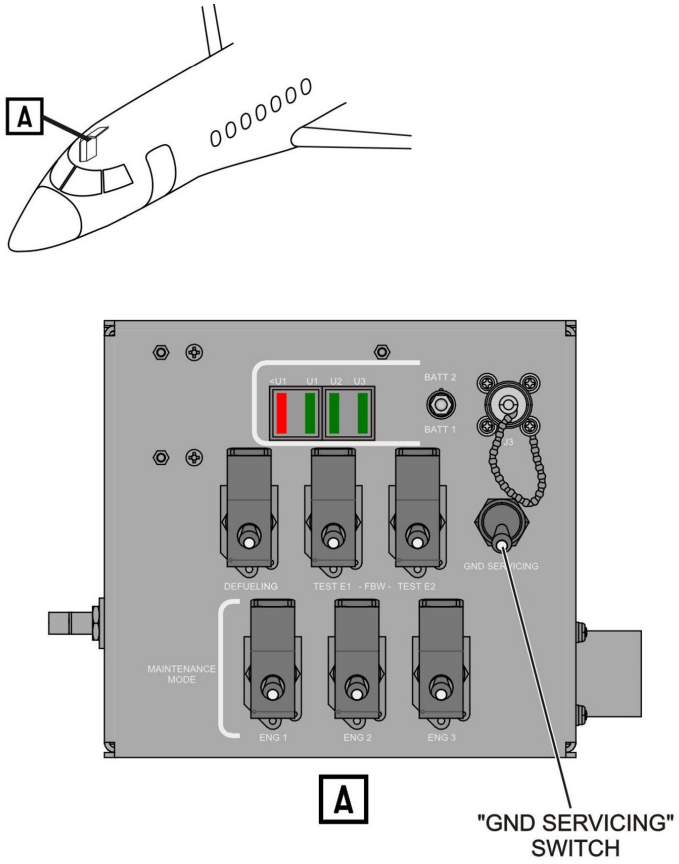


FIGURE 02-24-40-01 - MAINTENANCE PANEL - GND SERVICING SWITCH

- *Refer to Ground Servicing manual.*

BATTERIES BUS TEST

A three position switch located on the maintenance panel allows to check each battery bus tension.

This test allows to check the battery bus with avionics power off.

The BATT switch has 3 positions:

- One steady: middle (no test),
- 2 momentary:
  - Upper position allows to check BATT 2;
  - Lower position allows to check BATT 1.

The test feedback is displayed on battery voltage indicator available on the maintenance panel:

- Red vertical line U1,
- Green vertical line U1,
- Green vertical line U2,
- Green vertical line U3.

If only red line is lighted then the tested battery is not usable.

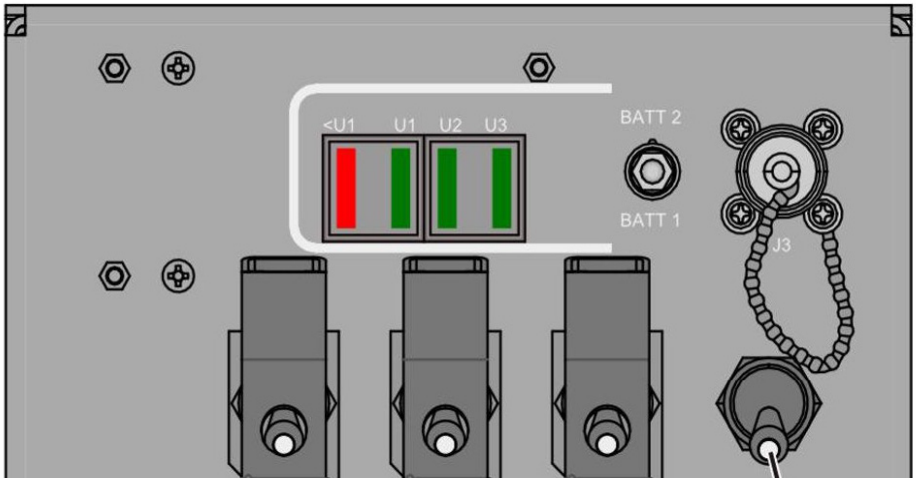


FIGURE 02-24-40-02 - MAINTENANCE PANEL - BATT SWITCH AND INDICATOR

CIRCUIT BREAKER STATUS PAGE

The status of an SSPC can be changed on the circuit breaker page, accessible through the TEST synoptic page (refer to 02-24-20). It will only be used per MMEL procedure.

The SSPC status can be changed only in the following conditions:

- The airplane is on ground,
- The park brake is pulled to the first notch position or higher.

The CHANGE SSPC STATE soft keys allow to change the status of the SSPC:

- 1) If the cyan selection box is on an electrical load where the state is IN, then the IN soft key is non actionable (since it is already in this state), the OUT soft key is selectable, and the LOCK soft key is non selectable. It can go from IN to OUT, but not from IN to LOCK.

- 2) If the cyan selection box is on an electrical load where the state is OUT, then the IN soft key is selectable, the OUT soft key is not selectable (since it is already in this state), and the LOCK soft key is selectable. It can go from OUT to IN and from OUT to LOCK.

- 3) If the cyan selection box is on an electrical load where the state is LOCK, then the IN soft key is non selectable, the OUT soft key is selectable, and the LOCK soft key is not selectable (since it is already in this state). It can go from LOCK to OUT, but not from LOCK to IN.

NOTE

It is necessary to click the soft key for at least 1.5 seconds to change the status of an SSPC.